XEROX

OPERATOR'S MANUAL

~~XEROX 600T 1616~~
TRUE RMS
DIGITAL MULTIMETER
WITH DIGALOG™ DISPLAY

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the Instrument for any measurements.

Manufactured for Xerox by:

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260

DIGITAL INSTRUMENT Warranty

SIMPSON ELECTRIC COMPANY warrants to Xerox, that each digital instrument manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any digital instrument which shall within one (1) year after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satsifaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any digital instrument which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

OPERATOR'S MANUAL

XEROX 600T1616 TRUE RMS DIGITAL MULTIMETER WITH DIGALOG™ DISPLAY

This symbol on the nameplate means the product is Listed by Underwriters Laboratories Inc.

The XEROX 600T1616 Digital Multimeter is identical, electrically, to the Simpson 467. All references, hereafter, to the Simpson 467 are the same as for the 600T1616.

Manufactured for Xerox by:

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260

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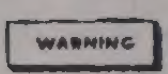
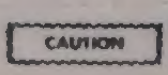
NOTE: This Operator's Manual contains information essential to the operation of this Instrument. Therefore, it should be kept in a convenient place and used for reference as required. (See Notes For The Record at the back of this manual.)

SAFETY SYMBOLS

This marking adjacent to another marking or a terminal or Operating device indicates that the Operator must refer to an explanation in the Operating Instructions to avoid damage to the equipment and/or to avoid personal injury.



This WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.



This CAUTION sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the Instrument.

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohms non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

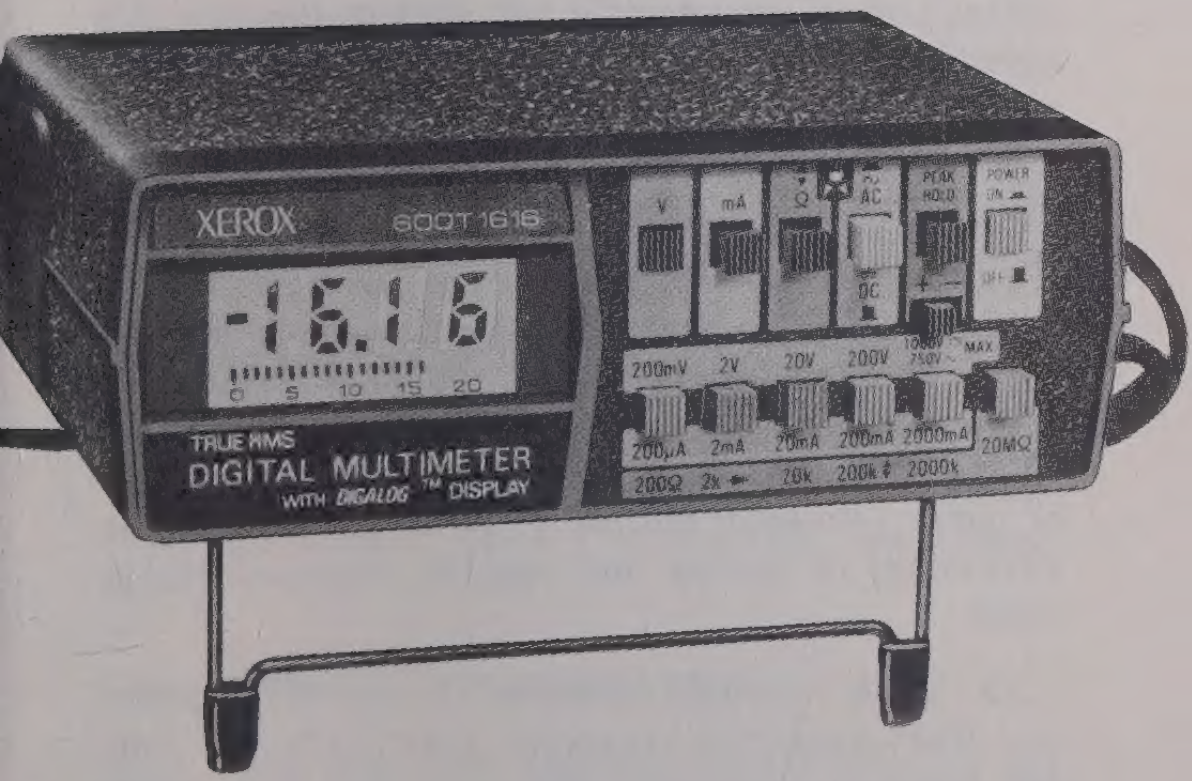


FIGURE 1-1.
XEROX 600T1616 DIGITAL MULTIMETER

SECTION I
INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson 467 Digital Multimeter offers the best of both worlds, a unique combination of digital and analog LCD display (Liquid Crystal Display) used to analyze both steady and pulsating signals, differential positive and negative peak-holding capability, and fast pulse detection and indication. In addition to the traditional voltage, current and resistance measurements of a 3½ digit multimeter, this versatile Instrument can actually replace the oscilloscope and the logic probe used in many applications.

1.1.2 In the differential peak mode, the Simpson 467 (hereafter referred to as the 467 or the Instrument) can make percent modulation and signal tracing measurements. In the pulse detection mode, the Instrument offers visual and/or audible indication of the presence of pulses and logic levels. The LCD analog bargraph display provides a rapid indication of either voltage or current signal levels, offering the advantages of nulling and peaking from an analog meter.

1.1.3 Other standard features of the 467 include: true RMS measuring capability, basic 0.1% DC voltage accuracy, continuity detection with both visual and audible indications, high voltage transient protection, excellent overload capability, double-fuse protection, and designed to meet the requirements of UL-1244, Safety Standard for Electrical and Electronic Measuring and Testing Equipment.

1.1.4 The 467 is designed to operate continuously for 200 hours in the DC voltage mode using a single

9V alkaline "transistor" battery (NEDA 1604A). A carbon-zinc type battery (NEDA 1604) may be substituted, with a reduction in operation to about 100 hours. A "B" symbol on the display is used to automatically indicate a low battery voltage, and to signify a remaining battery life of approximately 20 hours.

1.1.5 The 467 display consists of a single liquid crystal display that includes the following: numerical display, analog bargraph, and two triangular symbols for pulse and continuity indications. The numerical display has 3½ digit, 7-segment, high contrast numerals that are 0.4 inches high and are in a single plane for distant and wide-angle viewing. The analog bargraph is constructed with 20 segments, absolute value reading and left-hand zero.

1.2 ITEMS AND ACCESSORIES

1.2.1 All items and accessories required for the operation of the 467 are furnished with the Instrument and listed in Table 1-2. Available replacement parts are listed in Table 8-2.

1.3 SAFETY CONSIDERATIONS

1.3.1 This Operator's Manual contains cautions and warnings alerting the user to hazardous operating and servicing conditions. This information is flagged by CAUTION or WARNING headings throughout this publication, where applicable, and is defined at the front of this manual under SAFETY SYMBOLS. To ensure the safety of operating and servicing personnel and to retain the operating conditions of this Instrument, these instructions must be adhered to.

1.4 TECHNICAL DATA

1.4.1 Table 1-1 lists the technical data for the 467 Digital Multimeter.

TABLE 1-1. TECHNICAL DATA

The following electrical specifications are valid for an operating temperature of +18°C to +28°C at relative humidity up to 90 percent unless otherwise noted.

1. DC Volts:

Range	Maximum Indication	Input Resistance	Overload Protected to:
200 mV	±199.9 mV	10 MΩ All Ranges	1000 V (DC + Peak AC) All Ranges
2 V	±1.999 V		
20 V	±19.99 V		
200 V	±199.9 V		
1000 V	±1000 V (Max. Input)		

Accuracy: ±(0.1% of input + 1 count)

Sensitivity: 100 μV on 200 mV Range

Full Range Step Response: (to rated accuracy) 1 second

Normal Mode Rejection: 50 dB minimum @ 50/60 Hz

Common Mode Rejection: 120 dB minimum @ 50/60 Hz and DC with 1 kΩ unbalance

2. AC Voltage: (True RMS, AC Coupled)

Range	Maximum Indication	Accuracy		
		20 Hz to 40 Hz	40 Hz to 1 kHz	1 kHz to 5 kHz
200 mV	199.9 mV	± (1.5% of Input + 5 Counts)	± (0.5% of Input + 5 Counts)	± (5.0% of Input + 5 Counts)
2 V	1.999 V			
20 V	19.99 V			
200 V	199.9 V			
750 V	750 V (Max. Input)		to 400 Hz only	Not Specified

Input Impedance; 10 MΩ and <100 PF
All Ranges

Overload *
Protected to: 1000 V (DC + Peak AC)
or 750 V RMS All Ranges

Crest Factor: (at full scale) 3:1

Full Range Step Response:
(to rated accuracy) 3 seconds

* *Not to exceed the Volt-Hertz Product of* 10^7.

3. Resistance:

Range	Maximum Indication	Accuracy	Typical Open-Circuit Voltage
200 Ω	199.9 Ω	± (0.25% of Input + 1 Count)	2.4 V
2 kΩ	1.999 kΩ		2.4 V
20 kΩ	19.99 kΩ		.45 V
200 kΩ	199.9 kΩ		.45 V
2000 kΩ	1999 kΩ		.45 V
20 MΩ	19.99 MΩ	± (1.0% of Input + 1 Count)	2.4 V

Short-Circuit Test Current : 2 mA Max.

Overload Protected to: 750 V (DC + Peak AC) All Ranges

Full Range Step Response: 1 second except 20 MΩ range which is 7 seconds.

Diode Test: Diode symbol indicated on 2 kΩ range. Measures forward drop of a semiconductor junction, at approx. 0.5 milliamp.

4. DC Current:

Range	Maximum Indication	Accuracy	Burden Voltage
200 μA	±199.9 μA	±(0.5% of Input + 1 Count)	0.25 V Max.
2 mA	±1.999 mA		
20 mA	±19.99 mA		
200 mA	±199.9 mA	± (0.75% of Input + 1 Count)	
2000 mA	±1999 mA		1 V Max.

Overload Protected to: 2 Amps Double Fuse Protected All Ranges

Full Range Step Response: (to rated accuracy) 1 second

Overload Protection: 2A/250 V fuse and 3A/600 V fuse in series.

5. AC Current: (True RMS, AC Coupled)

Range	Maximum Indication	Accuracy		Burden Voltage
		20 Hz to 40 Hz	40 Hz to 1 kHz	
200 μA	199.9 μA	± (2.0% of Input + 5 Counts)	± (1.5% of Input + 5 Counts)	0.25 V Max.
2 mA	1.999 mA			
20 mA	19.99 mA			
200 mA	199.9 mA			
2000 mA	1999 mA			1 V Max

Overload Protected to: 2 Amps Double Fuse Protected All Ranges

Crest Factor: (at full scale) 3:1

Full Range Step Response: (to rated accuracy) 3 seconds

Overload Protection: 2A/250 V fuse and 3A/600 V fuse in series.

6. Bargraph:

Sensitivity:	10 mV on 200 mV range.
Accuracy:	± (5% of input + 1 segment).
Maximum Indication:	
200 mV through 200 V, and 200 μA through 200 mA ranges:	110% of range.
750 VAC, 1000 VDC, and 2000 mA ranges:	Limited to maximum input.
Full Range Step Response: (to rated accuracy)	150 m sec.

7. Differential Peak Hold (Switch Selectable For +, — Peaks)

DC Volt and DC Current:	
Accuracy:	±(1.0% of Input + 10 counts) DC V; ±(1.5% of input + 10 counts) DC I.
Acquisition Time:	10 mS minimum duration for square pulses.
Display Decay Rate:	1 Count/sec.
AC Volt and AC Current (100 Hz to 1 kHz):	
Accuracy:	+ (3% of Input + 10 Counts).
Acquisition Time:	200 mS minimum duration.

8. Absolute Value Pulse Detector: (200 k range)

Reference Level:	Approx. ±0.4 V.
Display:	"▲" for absolute values greater than reference. "▼" for absolute values less than reference (audio tone coincident with "▼" switch selectable). "▲▼" for inputs passing above and below reference.
Pulse Response:	50 μS (minimum width of a 0 to ±1 V pulse required to turn on display "▲". Pulse stretcher holds display for approx. 100 mS when narrow pulses are detected).
Input Impedance:	100 kΩ in parallel with <100 PF.
Overload Protection:	750 VDC or Peak AC.

9. Continuity: (2kΩ range)

Display:	"▲" open circuit. "▼" continuity (with switch activated tone).
Response Time:	50 μS (minimum duration of continuity or open to turn on display or audio tone). Pulse stretcher holds display and tone for approx. 100 mS.
Overload Protection:	750 VDC or Peak AC All Ranges.

10. Rated Circuit-To-Ground Voltage: (maximum common mode voltage) ⚠	1000 Volts (DC + Peak AC) Maximum from any input terminal to power-line (earth) ground.
11. Transient Protection:	Protected against transients on all voltage and resistance ranges: 6 kV @ 100 μS.
12. Display:	
Numerical Display:	3½ digit, 7 segment, 0.4" LCD.
Analog Bargraph:	20 segment LCD bargraph with 2 segments overrange. Absolute value reading. Lefthand zero. (22 segments total).
Conversion Rate:	
Numerical Display:	3 readings per second, nominal.
Bargraph:	60 readings per second, nominal.
DC Polarity Selection:	Automatic "—" indication, "+" implied.
13. Power Requirements:	
Battery Life:	200 hours with alkaline battery. *
Battery Type:	(1) 9-volt alkaline "transistor" battery (NEDA 1604A).
Low Battery Indicator:	Automatically displays "B" to signify a remaining battery life of approximately 20 hours.

* *Applies to DC volt and DC current ranges only.*

14. Temperature Range:

Operating:	0° to +55°C.
Storage:	−40°C to +70°C.

15. Temperature Coefficient: (0°C to +18°C and +28°C to +55°C) — Less than 0.1 times the applicable accuracy specification per °C.

16. Relative Humidity:

Operating: 90% maximum up to +35°C; 70% maximum up to +55°C (non-condensing).

17. Dimensions:

Height:	2 in. (50.8 mm).
Width:	5.63 in. (143 mm).
Depth:	4.6 in. (116.8 mm).

18. Weight: Approx. 1.5 lbs.

TABLE 1-2. ITEMS AND ACCESSORIES FURNISHED WITH THIS INSTRUMENT

Quantity	Description	Part No.
1	Operator's Manual	6-112400
1	Condensed Operating Instructions	6-112401
1	Battery, 9V Alkaline (NEDA 1604A)	5-114907*

**Retail item.*

SECTION II
INSTALLATION

2.1 GENERAL

2.1.1 This section contains instructions for the installation and shipping of the 467. Included are unpacking and inspection procedures, warranty, shipping, power source requirements, and installation.

2.2 UNPACKING AND INSPECTION

2.2.1 Examine the shipping carton for obvious signs of damage. If damage is suspected open the carton and inspect the Instrument for possible damage. If damage is noted, notify the carrier and supplier prior to using the Instrument. If the Instrument appears to be in good condition, read this Operator's Manual in its entirety. Then run a series of familiarity tests as instructed in this manual. Also, check that all items are included with the Instrument (Table 1-2).

2.3 WARRANTY

2.3.1 The Xerox/Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact the Xerox Authorized Service Center (listed on the last page of this Manual). If it is necessary to contact Xerox directly, give full details of any difficulty and include the Instrument model number, serial number (at the back of this Instrument) and date of purchase. Shipping instructions will be mailed promptly. If an estimate of charges for non-warranty or other service work is required, an estimate will be quoted. This charge will not be exceeded without prior approval.

2.4 SHIPPING

2.4.1 Pack the Instrument carefully and ship it prepaid and insured to the proper destination.

2.5 POWER SOURCE REQUIREMENTS

2.5.1 The 467 is a battery-operated Instrument. An alkaline 9V "transistor" battery is factory installed in the Instrument. (See item 13, Table 1-1 for battery type and paragraph 7.3 for installation.)

2.6 INSTALLATION

2.6.1 The Instrument may be operated in a horizontal (on its rubber feet) or vertical (on its back) position. It can also be set at an inclined angle by positioning the stand under the unit.

SECTION III
CONTROLS, CONNECTORS, AND INDICATORS

3.1. GENERAL

3.1.1 Before attempting any operation of the 467, become familiar with each control. A thorough understanding of how the Instrument operates will avoid undue mistakes and prolong the life of the Instrument.

3.2 FRONT AND SIDE PANEL DESCRIPTION

3.2.1 This section, consisting of Table 3-1 and Figures 3-1 and 3-2, will describe the proper function of the 467.

TABLE 3-1.
FRONT AND SIDE PANEL DESCRIPTION

1. POWER Switch: ON ▬ OFF ▙	Pushbutton switch used to apply or turn off power to the Instrument.
2. Function Switches:	Connect the input to the appropriate measuring circuits as follows:
V	Selects the DC voltage or AC voltage measuring circuit, depending on the position of the DC/AC pushbutton switch.
mA	Selects the DC current or AC current measuring circuit, depending on the position of the DC/AC pushbutton switch.

▲▼ Ω	Selects the resistance measuring circuits in conjunction with the selection of any one of the six resistance range pushbutton switches; or selects pulse detection mode in conjunction with the selection of the 200 k ▲▼ pushbutton switch; or selects DIODE TEST in conjunction with the selection of the 2 k ⊣▶⊢ pushbutton switch; or selects CONTINUITY TEST IN conjunction with the selection of the 2 k range. Continuity occurs with resistance of 500 ohms or less in the 2 k range.
♪ ~ AC ⎓ DC	The IN position selects the AC voltage or AC current measuring circuit, depending on the selection of either the V or mA pushbutton switch; or selects the audible buzzer for pulse detection and CONTINUITY in conjunction with the selection of the ▲▼ Ω and the appropriate resistance range pushbutton switches.
PEAK HOLD "±"	In conjunction with the "±" slide switch, selection of this pushbutton switch can be used to capture positive or negative peaks on any range of voltage or current being measured.

3. Range Switches: Selects the appropriate circuits required to obtain full range measurements as follows:

Voltage:	200mV, 2V, 20V, 200V, 1000VDC/750VAC
Current:	200μA, 2mA, 20mA, 200mA, 2000mA
Resistance:	200Ω, 2k, 20k, 200k, 2000k, 20MΩ
Continuity:	2k range
Diode Test:	2k
Pulse Detection:	200k

4. Display:

Numerical: The numerical display is a single LCD which includes a "—" polarity sign, ("+" sign is implied) a "1" digit, three 7-segment 0 to 9 digits and a programmed decimal point, to indicate the polarity and the value of the signal being measured. Overrange (out-of-range) conditions are indicated by a blank display, but with the most significant "1" digit displayed.

Analog Bargraph: The LCD analog bargraph consists of 20 regular segments and 2 overrange segments. The analog bargraph provides absolute value reading and a left-hand zero scale.

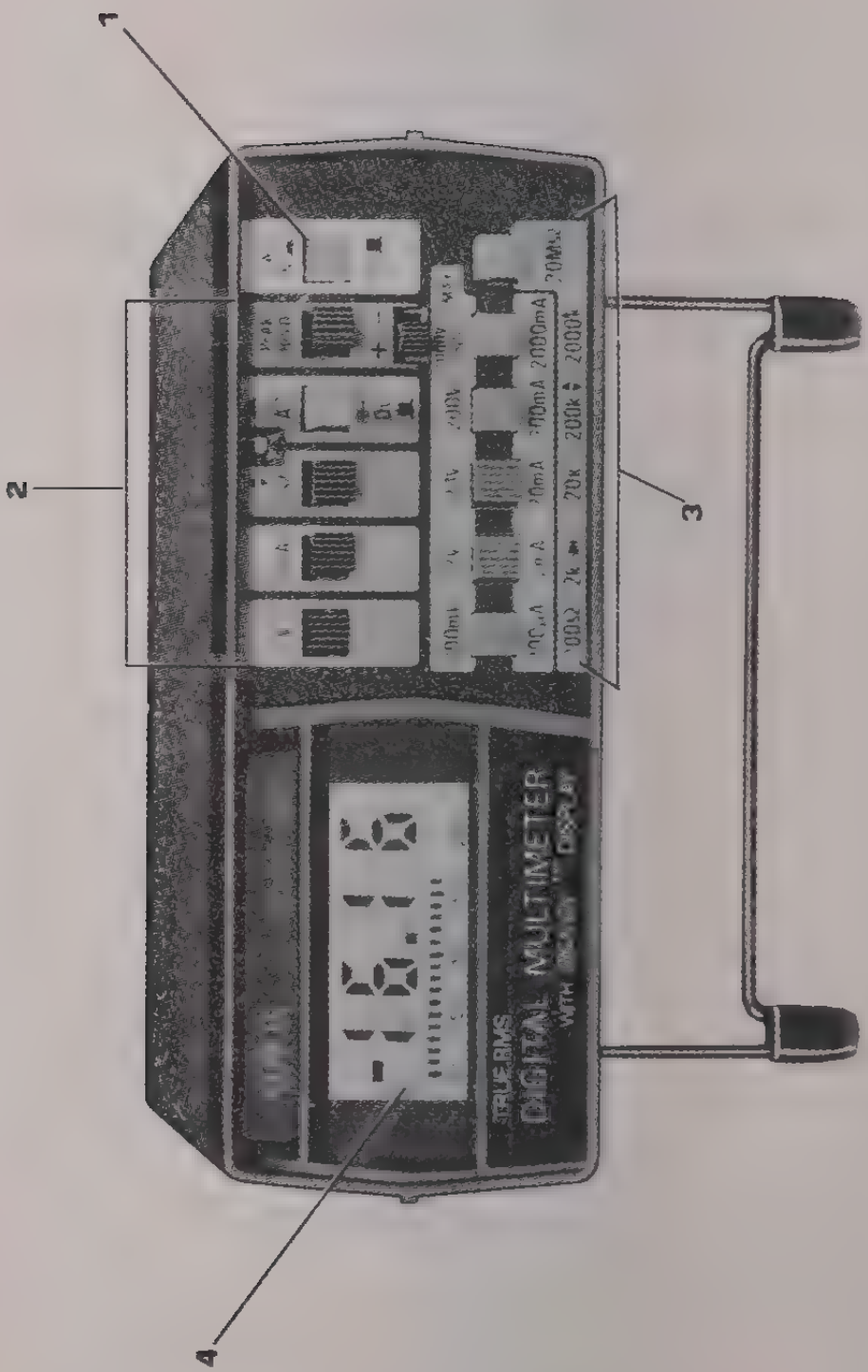


FIGURE 3-1. FRONT PANEL DESCRIPTION

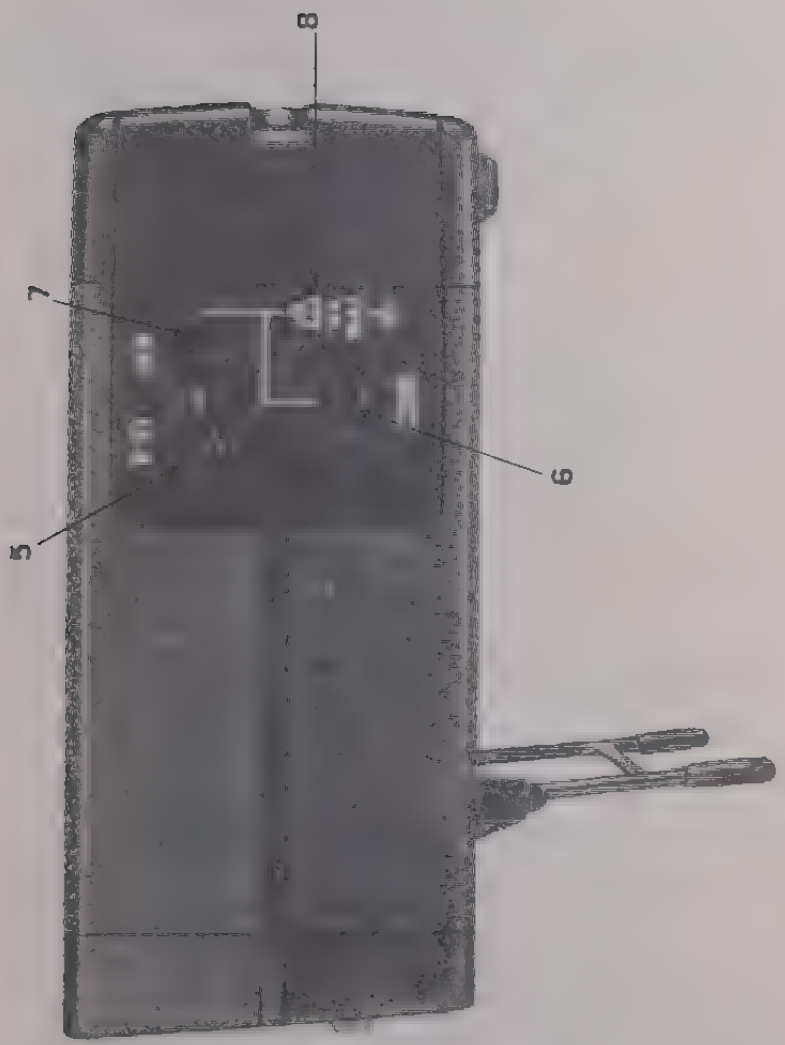


FIGURE 3-2.
RIGHT SIDE PANEL DESCRIPTION

Pulse Detection: "▲" for absolute values greater than approximately ±0.4 volt.
"▼" for absolute values less than ±0.4 volt.

Continuity: "▲" for open circuit.
"▼" for indication of continuity.

Low Battery: Low battery condition is indicated by the symbol "B" located in the upper left-hand corner of the display. The first appearance of the arrow signifies a remaining battery life of approximately 20 hours.

5. V-Ω Jack: This jack is used to connect, via the red test lead, the "high" or "+" side of the circuit being measured to all voltage and resistance measuring circuits through the range and function switches.

6. Com Jack: This jack is used to connect, via the black test lead, the "low" or "—" side of the circuit being measured to the internal circuit COMMON. **Do not float this terminal more than 1000 (DC plus AC peak) volts away from earth ground.**

7. mA Jack: This jack is used to connect, via the red test lead, the "high" or "+" side of the circuit being measured to the current measuring circuits through the range and function switches.

8. ⚠ Refer to Table 1-1, item 10.

SECTION IV
OPERATING INSTRUCTIONS

4.1 GENERAL

VOLTAGES ENCOUNTERED WITHIN THE CAPABILITIES OF THIS INSTRUMENT ARE DANGEROUS AND CAN BE FATAL. READ AND FOLLOW FULLY THE INSTRUCTIONS PROVIDED IN THIS OPERATOR'S MANUAL AND ADHERE TO THE FOLLOWING:

4.1.1 Turn off circuit power before connecting and disconnecting test leads.

4.1.2 Do not float the input terminals more than 1000 volts (DC + peak AC) from earth ground.

4.1.3 Do not use this Instrument for making measurements in high voltage and high power circuits unless qualified to do so.

4.1.4 Do not exceed the following input limits:

Function	Maximum Input
AC/DC Volts	1000V (DC + peak AC)
AC/DC mA	2A (Fuse Protected)
OHMS	750V (DC + peak AC)

Failure to stay below these limits can lead to personal injury and/or damage to the Instrument.

4.1.5 For maximum safety, do not touch test leads, circuit, or Instrument while power is applied to the circuit being measured.

4.2 BATTERY

4.2.1 This Instrument is powered by one 9V alkaline battery (NEDA 1604A).

4.2.2 A "B" indicator will appear in the display when the remaining battery life has dropped to approximately 20 hours. (See paragraph 7.3 for battery replacement.)

4.3 CURRENT RANGE FUSES

4.3.1 There are two fuses, F1 and F2, in series in the current measuring circuit. They are rated at 2A, 250V (3AG Normal BLO) and 3A/600V (BBS) respectively.

4.3.2 To check for a blown fuse, depress the "Ω" and "2k" buttons. Connect the "V-Ω" and "mA" input jacks together. The meter should read approximately .100. If the meter indicates overrange, one or both of the fuses is blown. (See paragraph 7.4 for fuse replacement.)

4.4 DC VOLTAGE MEASUREMENTS:

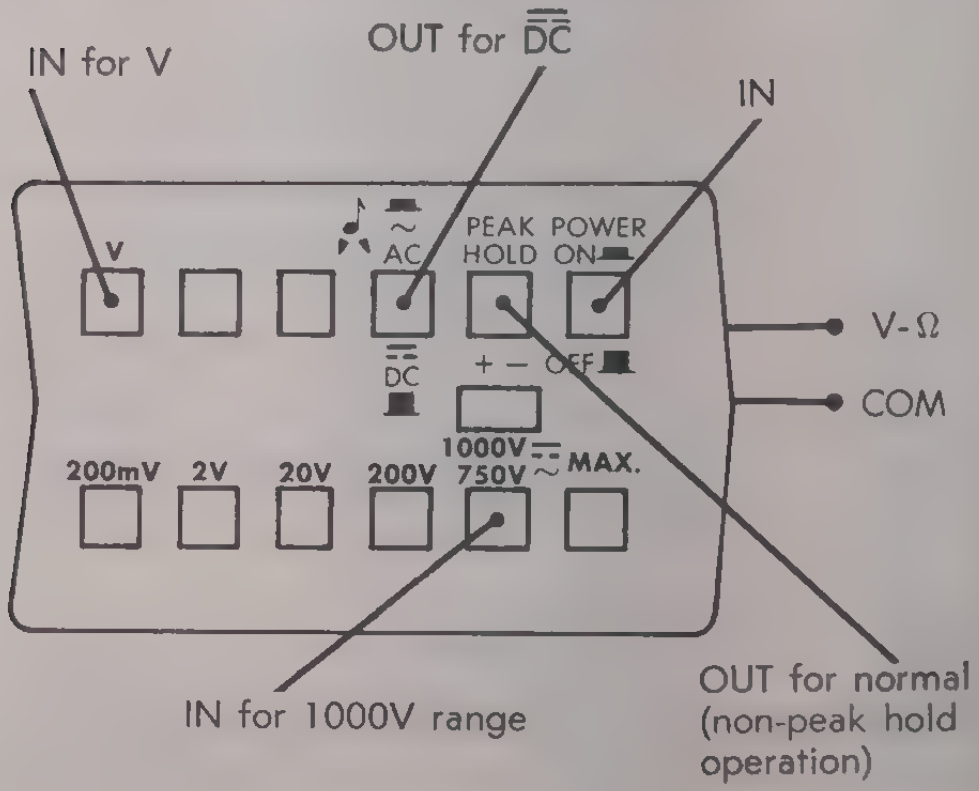


FIGURE 4-1. DC VOLTS

a. Review the Safety Precautions in paragraph 4.1.

b. Connect the red test lead to the V-Ω jack and the black lead to the COM jack.

c. Depress the "V" function switch.

d. Set the $\tilde{AC}$, $\bar{\bar{DC}}$ pushbutton switch to the $\bar{\bar{DC}}$ (OUT) position.

e. Set the PEAK HOLD switch to the OUT position for normal operation.

f. Depress the appropriate voltage range switch. If the voltage being measured is unknown, begin with the 1000 volt DC range switch.

WARNING

Do not attempt to measure voltages on the 1000 VDC range which might be greater than 1000 volts DC.

g. REMOVE ALL POWER FROM THE CIRCUIT BEING MEASURED AND DISCHARGE ALL CAPACITORS.

h. Connect test leads to the circuit being measured.

i. Apply power to the circuit being measured. The Instrument will automatically indicate the correct polarity, "—" to indicate negative and no sign to imply positive polarity. The value of the voltage being measured will be indicated on both the numerical and analog bargraph displays.

j. Remove all power from the circuit being measured and discharge all capacitors prior to disconnecting test leads.

4.5 AC VOLTAGE MEASUREMENTS:

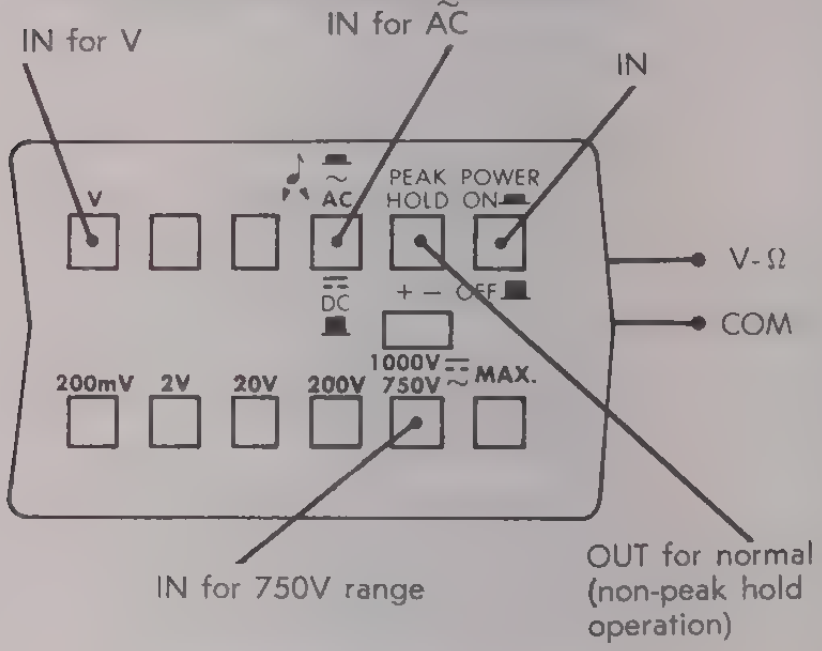


FIGURE 4-2. AC VOLTS

a. Review the Safety Precautions in Paragraph 4.1.

b. Connect the red test lead to the V-Ω jack and the black lead to the COM jack.

c. Depress the "V" function switch.

d. Set the ~, ⎓ pushbutton switch to the ~ (IN) position.

e. Set the PEAK HOLD switch to the OUT position for normal operation.

f. Depress the appropriate voltage range switch. If the voltage being measured is unknown, begin with the 750 VAC range switch.

WARNING

Do not attempt to measure voltages on the 750 VAC range which might be greater than 750 volts.

g. Remove all power from the circuit being measured and discharge all capacitors.

h. Connect test leads to the circuit being measured.

i. Apply power to the circuit being measured. The value of the voltage being measured will be indicated on both the numerical and analog bargraph displays.

j. Remove all power from the circuit being measured and discharge all capacitors prior to disconnecting test leads.

4.6 DC CURRENT MEASUREMENTS:

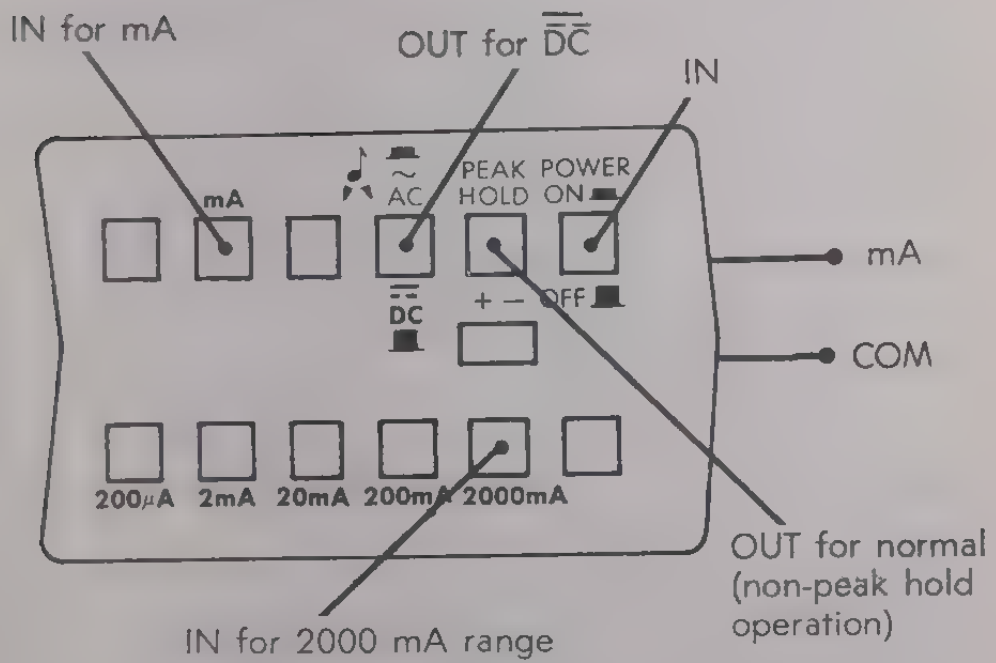


FIGURE 4-3. DC mA

a. Review the Safety Precautions in Paragraph 4.1.

b. Depress the "mA" function switch.

c. Set the $\tilde{A}C$, $\overline{\overline{D}}C$ pushbutton switch to the $\overline{\overline{D}}C$ (OUT) position.

d. Set the PEAK HOLD switch to the OUT position for normal operation.

e. Depress the appropriate current range switch. If the current being measured is unknown, begin with the 2000 mA range.

f. Connect the red test lead to the mA jack and the black test lead to the COM jack.

g. REMOVE ALL POWER TO THE CIRCUIT BEING MEASURED AND DISCHARGE ALL CAPACITORS.

h. Open the circuit in which the current is to be measured and securely connect the test leads in series.

WARNING

Ensure that a current range is never connected across a voltage source and that the circuit into which the 467 is connected (in series) does not have a voltage, with respect to ground, exceeding the rated circuit-to-ground voltage of 1000 volts (DC plus AC peak).

i. Apply power to the circuit being measured.

j. The value of current being measured is indicated on the numerical display.

k. REMOVE ALL POWER FROM THE CIRCUIT BEING MEASURED AND DISCHARGE ALL CAPACITORS.

l. Disconnect the test leads and reconnect the circuit which was originally opened.

4.7 AC CURRENT MEASUREMENTS:

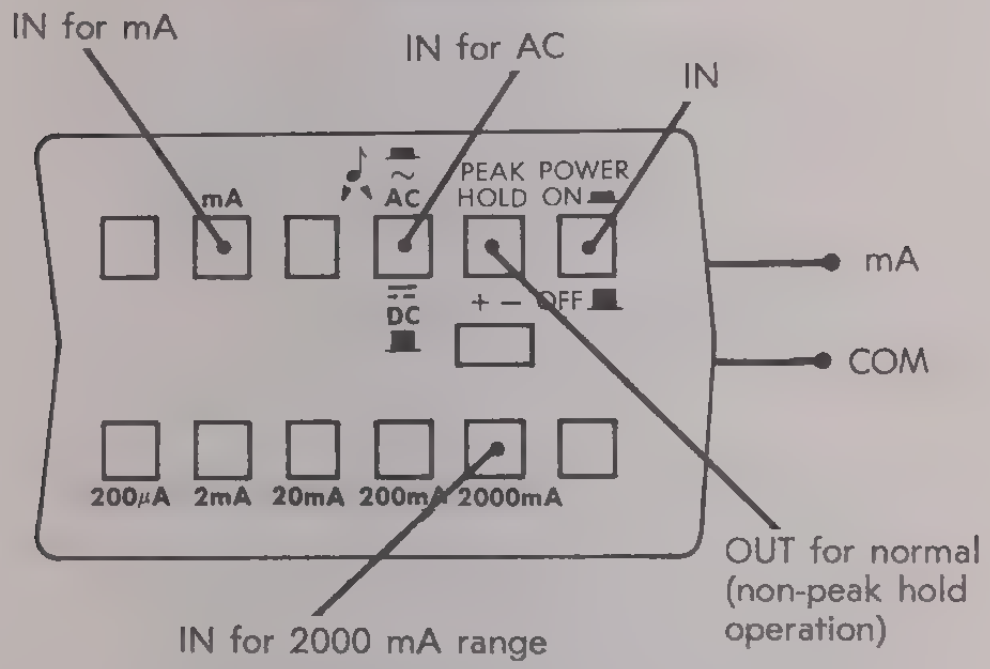


FIGURE 4-4. AC mA

a. Review the Safety Precautions in Paragraph 4.1.

b. Depress the "mA" function switch.

c. Set the $\tilde{A}C$, $\overline{\overline{D}}C$ pushbutton switch to the $\tilde{A}C$ (IN) position.

d. Set the PEAK HOLD switch to the OUT position for normal operation.

e. Depress the appropriate current range switch. If the current being measured is unknown, begin with the 2000 mA range.

f. Connect the red test lead to the mA jack and the black test lead to the COM jack.

g. REMOVE ALL POWER FROM THE CIRCUIT BEING MEASURED AND DISCHARGE ALL CAPACITORS.

WARNING

Ensure that a current range is never connected across a voltage source and that the circuit into which the 467 is connected (in series) does not have a voltage, with respect to ground, exceeding the rated circuit-to-ground voltage of 1000 volts (DC plus AC peak).

h. Open the circuit in which the current is to be measured and securely connect the test leads in series.

i. Apply power to the circuit being measured.

j. The value of the current being measured is indicated on the numerical display.

k. REMOVE ALL POWER FROM THE CIRCUIT BEING MEASURED AND DISCHARGE ALL CAPACITORS.

l. Disconnect the test leads and reconnect the circuit which was originally opened.

4.8 RESISTANCE MEASUREMENTS:

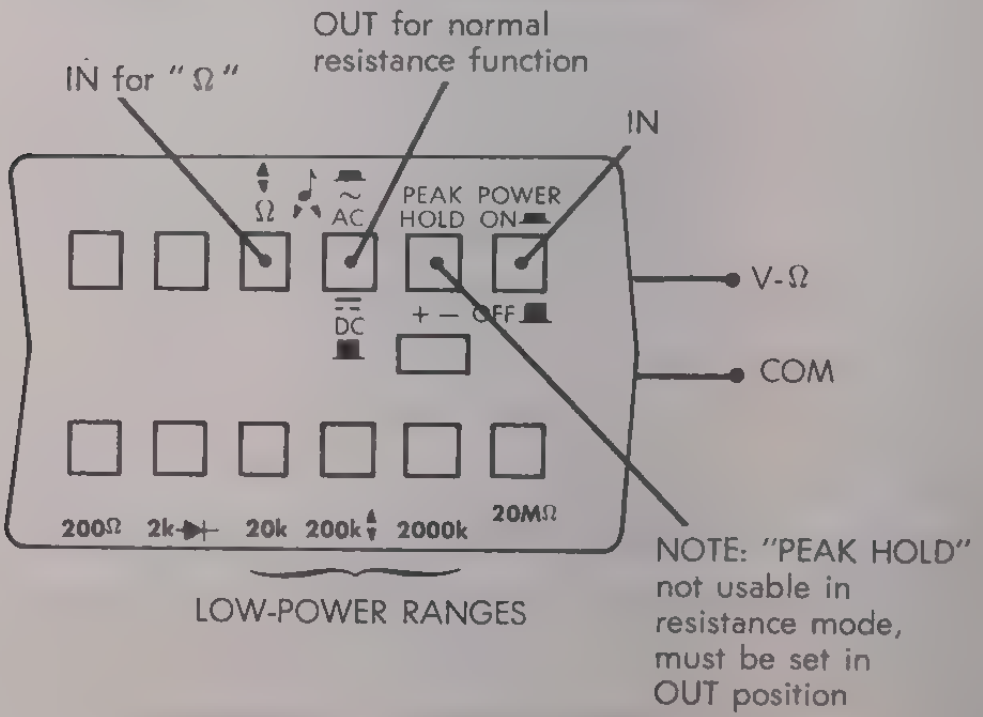


FIGURE 4-5. RESISTANCE

a. Connect the red test lead to the V-Ω jack and the black lead to the COM jack.

b. Depress the "Ω" function switch.

c. Depress the appropriate resistance range switch:

   (1) Low Power (0.45V open-cricuit voltage) 20k, 200k, and 2000k ranges.

   (2) Standard Power (2.4V open-circuit voltage) 200Ω, 2k, and 20 MΩ ranges.

d. If the resistance being measured is connected into a circuit, be certain that all power is removed from the circuit and all capacitors are discharged. Check for current paths other than through the resistance being measured. These paths can result in a measured value which is lower than the actual value of the resistance being measured.

e. Connect the test leads to the resistance being measured. Be careful not to contact adjacent points, even if insulated, particularly when making high resistance measurements. Some insulators can have relatively low insulation resistance, which can sufficiently shunt the resistance being measured to result in a measured value lower than the actual value.

f. Allow time for the display to stabilize. This procedure is especially important when measuring a high value resistance shunted by a large value of capacitance.

g. Disconnect test leads.

4.9 CONTINUITY MEASUREMENTS:

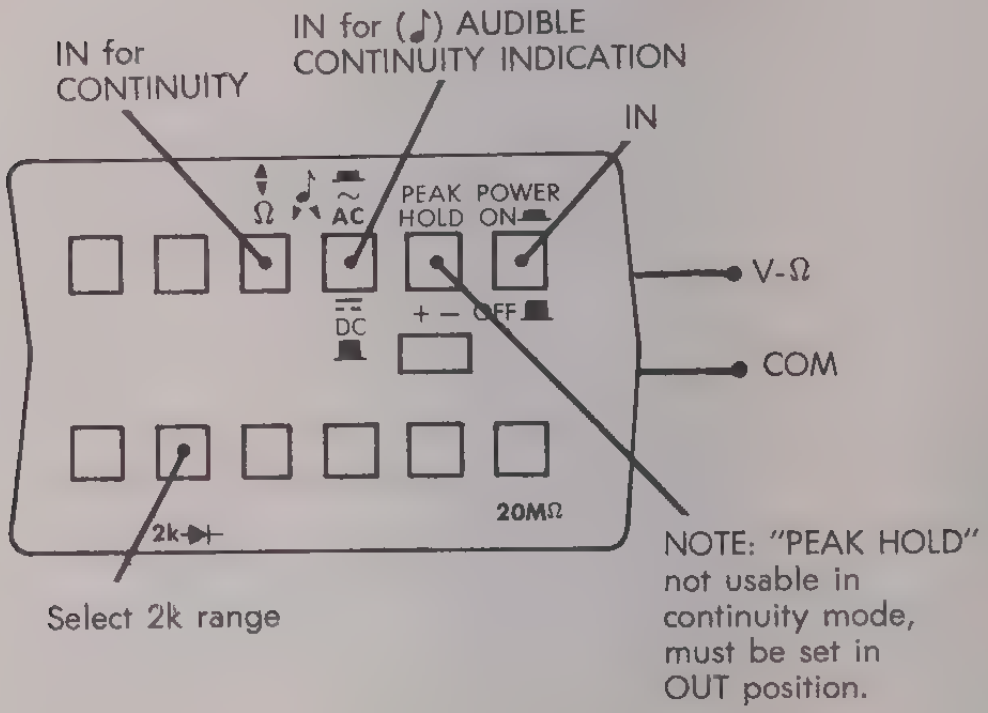


FIGURE 4-6. CONTINUITY

a. Connect the red test lead to the V-Ω jack and the black test lead to the COM jack.

b. Depress the "Ω" pushbutton switch.

c. Depress the "2k" range switch.

d. Continuity is indicated by a downward pointing arrow "▼".

e. Depress the "♪" pushbutton switch for an audible continuity indication.

f. The Instrument responds to continuity of 50 μS or longer duration.

4.10 DIODE TEST:

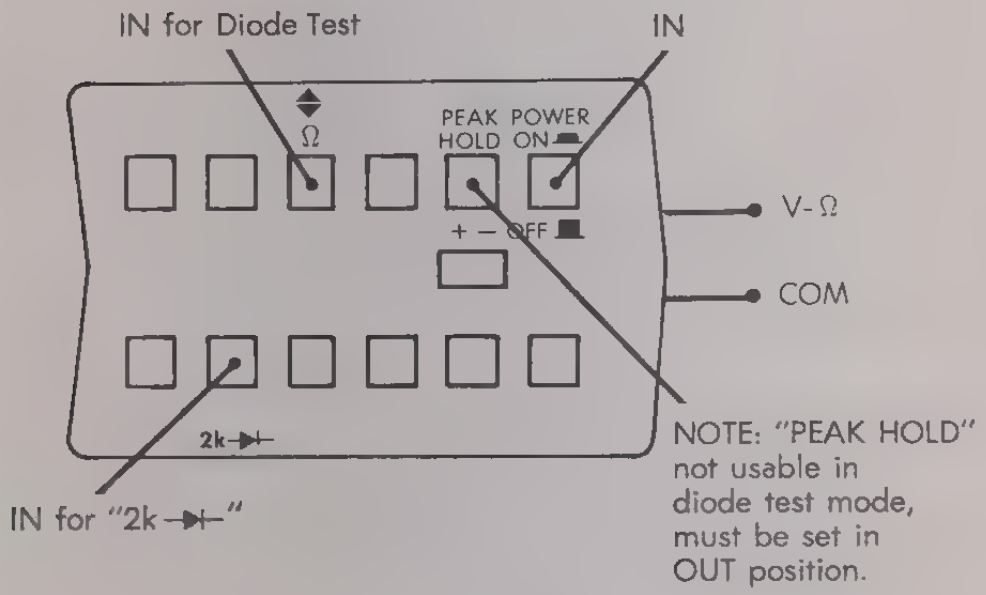


FIGURE 4-7. DIODE TEST

a. The diode to be tested must be out of circuit.

b. Connect the red test lead to the V-Ω jack and the black test lead to the COM jack.

c. Depress the "Ω" pushbutton switch.

d. Depress the "2k" range switch.

e. Connect the "V-Ω" test probe to the anode of the diode and the "COM" test probe to the cathode of the diode.

f. The voltage drop with a 0.5 mA current will be displayed. A reading of .550 to .950 V is a typical value for silicon diodes.

g. Reverse the leads; the numerical display should show overrange.

4.11 PEAK HOLD:

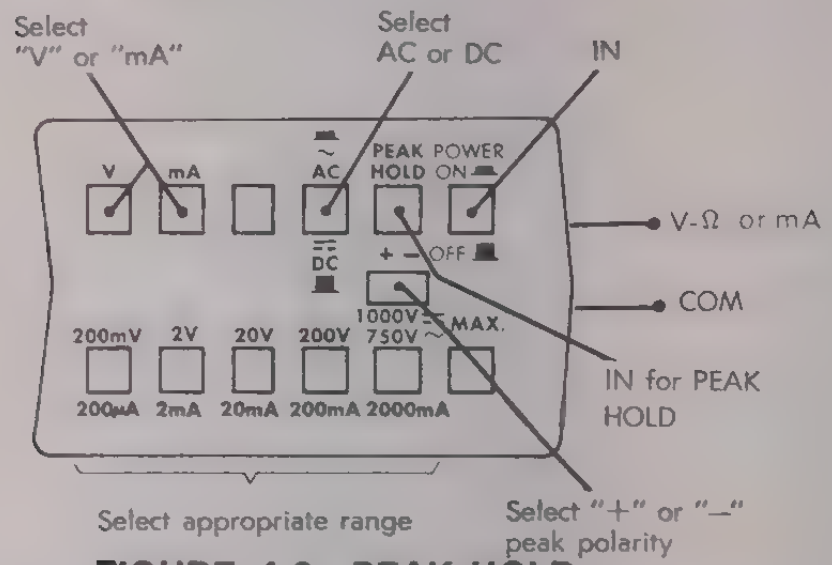
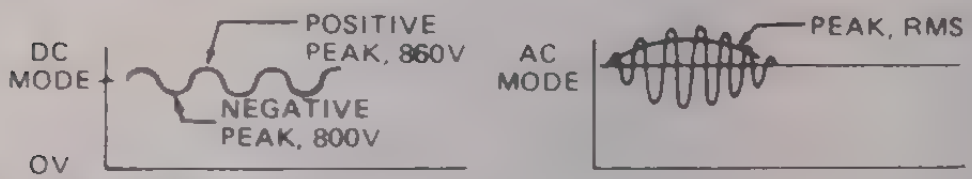


FIGURE 4-8. PEAK HOLD

4.11.1 PEAK HOLD can be used to capture positive or negative peaks of voltages and currents on the digital display.



4.11.2 Procedures:

a. Follow the procedure (and warnings) listed for the function desired.

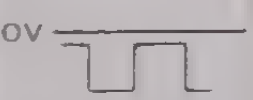
b. To measure peaks, operate the PEAK HOLD control switches as described below for the appropriate input condition (A, B, or C).

c. To make a new measurement, first release the PEAK HOLD switch (out position) to clear the previous reading.

CAUTION

Using PEAK HOLD in the Resistance Measurement mode will result in erroneous readings.

PEAK HOLD SWITCH OPERATION

	CONDITION A	CONDITION B	CONDITION C
			
For holding the most POSITIVE value	1 Set the "±" switch to the "+" position 2 Set the "PEAK HOLD" switch to the "IN" position	1 Set the "±" switch to the "+" position. 2. Set the "PEAK HOLD" switch to the "IN" position.	1. Perform the procedure below for most NEGATIVE value. 2. Set the "±" switch to the "+" position
For holding the most NEGATIVE value	1 Perform the procedure above for the most POSITIVE value. 2. Set the "±" switch to the "-" position	1. Set the "±" switch to the "-" position 2 Set the "PEAK HOLD" switch to the "IN" position	1 Set the "±" switch to the "-" position 2. Set the "PEAK HOLD" switch to the "IN" position

4.12 ABSOLUTE VALUE PULSE DETECTOR:

NOTE: In the absolute value pulse detector mode, the reading of the digital display is meaningless.

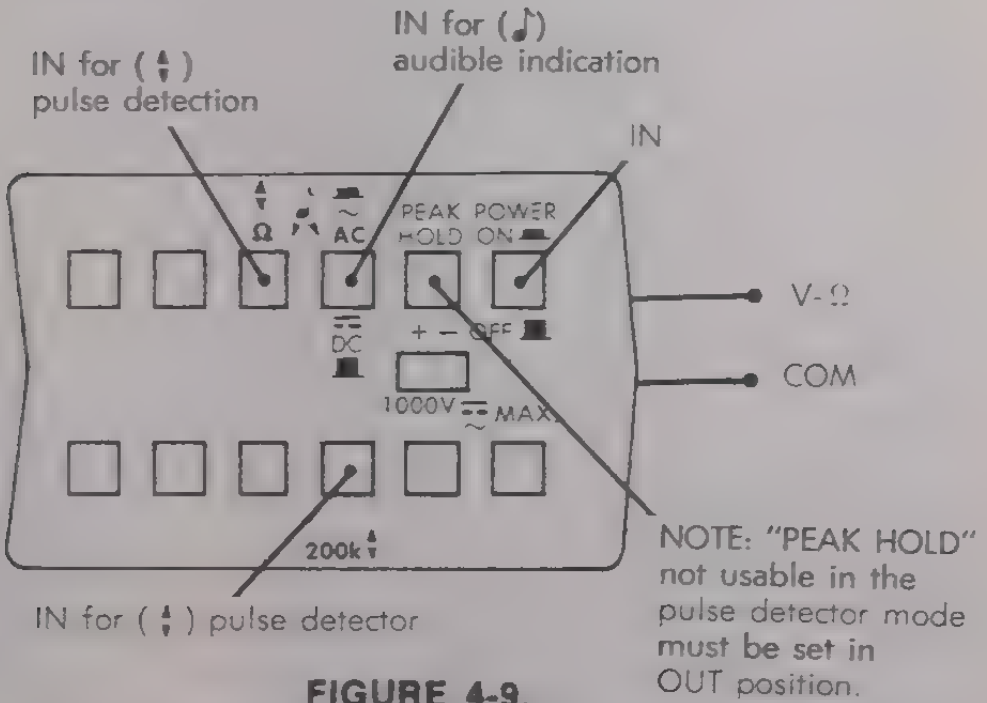


FIGURE 4-9.
ABSOLUTE VALUE PULSE DETECTOR

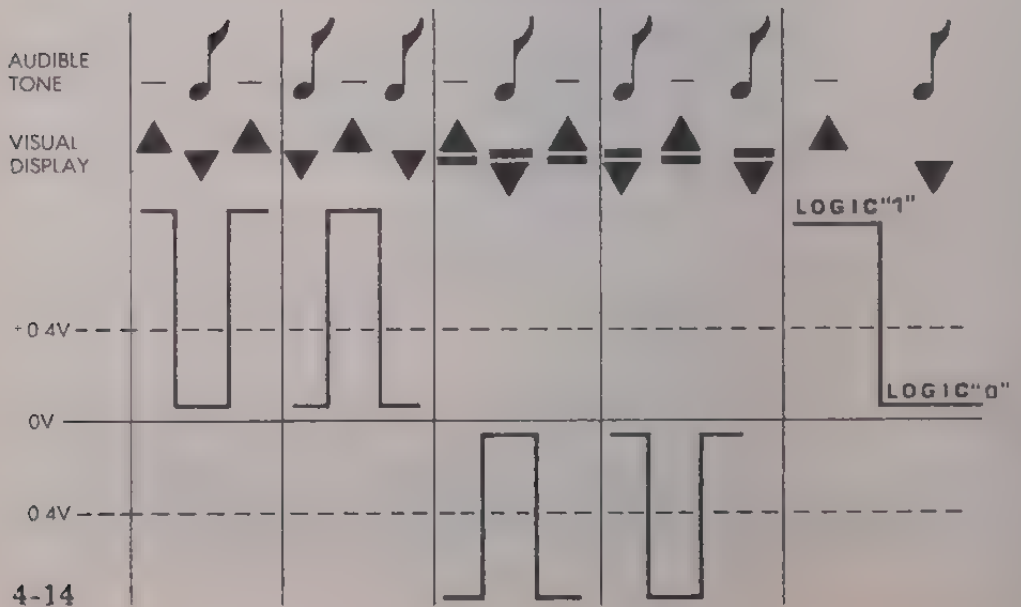
4.12.1 The absolute value pulse detector automatically detects and indicates the presence of either positive or negative pulses.

4.12.2 To be detected, the pulse must have a minimum pulse width of 50 μS and must exceed a reference level of approximately $\pm$0.4VDC.

4.12.3 Procedures:

a. Connect the test probes to the "V-Ω" and "COM" input jacks.
b. Depress the "Ω" and "200 k" switches.
c. If an audible signal (corresponding to the "▼" arrow) is desired, depress the ♪ ÃC switch.
d. Follow the instructions and observe the warnings listed for the resistance function.
e. The display and buzzer indications for various input signals are shown below:

PULSE & LOGIC LEVEL DETECTION MODES



4.13 ANALOG BARGRAPH DISPLAY

4.13.1 The analog bargraph display provides a rapid indication of either voltage or current signal levels, offering the advantages of an analog meter in a digital instrument.

4.13.2 The bargraph reading corresponds to the numerical reading in both AC/DC volts and AC/DC mA functions. In addition, the bargraph can be used to perform the following:

a. In DC volts or DC mA functions, follow changes in varying inputs. Applications would include nulling, peaking, and observation of AC frequencies below 30 Hz.

b. Observe instantaneous AC/DC volts or AC/DC mA readings when PEAK HOLD is in use. The input will still be monitored and displayed on the bargraph after PEAK HOLD has captured a peak on the numerical display.

4.13.3 The bargraph displays absolute values, with "—" polarity provided by the numerical display; "+" is implied.

4.13.4 The bargraph will display 110% of the range selected. An arrow pointing to the right indicates overrange conditions.

SECTION V
THEORY OF OPERATION

5.1 OVERALL SYSTEM

5.1.1 The basic system block diagram for the 467 is shown in Figure 5-1.

5.1.2 Signal Conditioning Section

5.1.3 The parameter being measured is connected to the input terminals. The corresponding Signal Conditioning circuits convert this parameter into a proportional DC voltage. The conversion is accomplished by the Attenuator, Current Shunts, Resistance Converter, Peak Hold, True RMS to DC Converter, and associated switching.

5.1.4 Analog-To-Digital Converter Section

5.1.5 The A D converter section consists of the basic A D Converter, the Bargraph Converter, and the Pulse and Continuity Detector. The A D two-slope converter changes the DC output voltage from the signal conditioning section to digital information to drive the numerical display. The single-slope Bargraph converter changes the DC output voltage from the signal conditioning section to drive a 22-segment bargraph display. The Pulse and Continuity Detector determines whether or not the conditioned input DC voltage level or pulse exceeds a predetermined reference level and appropriately activates either the upward or downward arrow on the display.

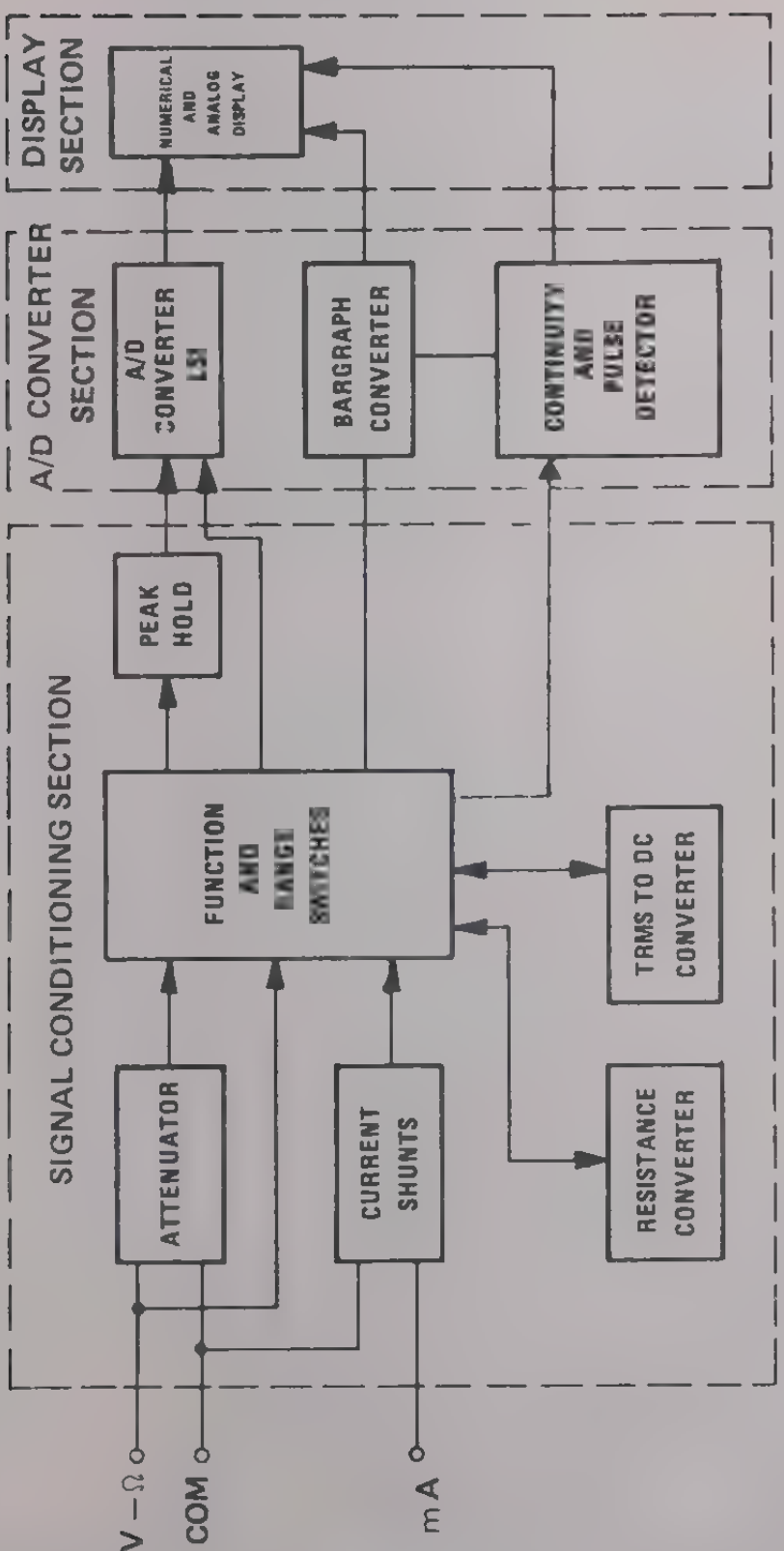
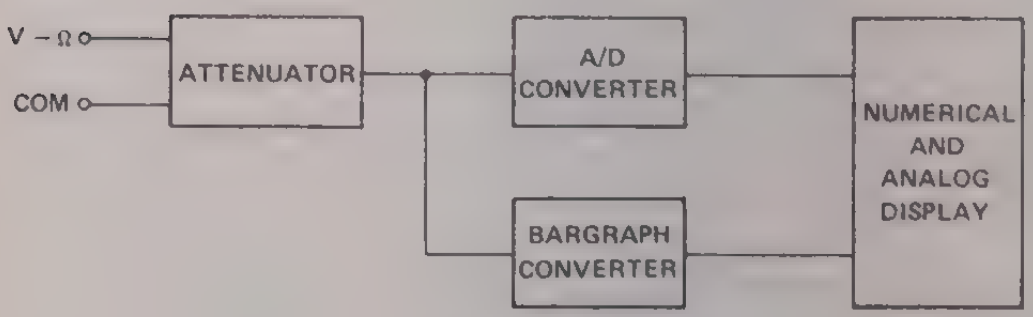


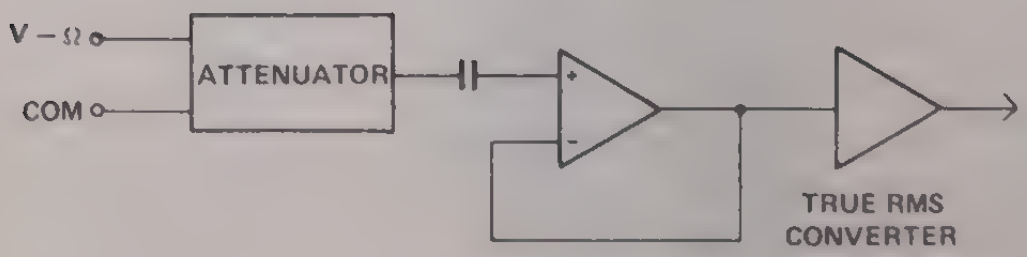
FIGURE 5-1. BASIC SYSTEM DIAGRAM

5.1.6 Display Section

5.1.7 The A D converter decodes the BCD into 7-segment information by the onboard decoder-driver. The numerical display is driven directly by the A/D converter LSI chip. The digital information from the bargraph converter is fed into a shift register, which in turn drives the 22-segment analog bargraph. The arrows are being driven by the pulse and continuity detector to indicate the level of the incoming DC voltage or pulse.



A. DC VOLTAGE



B. AC VOLTAGE

FIGURE 5-2.
BASIC VOLTAGE MEASUREMENT CIRCUITS

5.2 INPUT CIRCUITS

5.2.1 DC Voltage Measurements

5.2.2 The basic DC Voltage circuit is shown in Figure 5-2(A). The DC Voltage being measured is connected to the "V-Ω" and "COM" jacks, attenuated according to the range selected and converted into digital information by the A/D converter.

5.2.3 The A/D Converter provides a basic 200mV sensitivity range. The input voltage being measured is attenuated to provide 200 mV by the input divider network. The divider network is used on the 2V, 20V, 200V and 1000 Volt ranges.

5.2.4 AC Voltage Measurements

5.2.5 The basic AC voltage measurement circuit is shown in Figure 5-2(B). The AC voltage being measured is connected to the "V-Ω" and "COM" jacks, attenuated according to the range selected and applied to the amplifier. The output of the amplifier is converted into DC voltage by a True RMS converter and the resulting 200 mV DC voltage is measured by the A D Converter. A buffer is used between the attenuator and the True RMS converter.

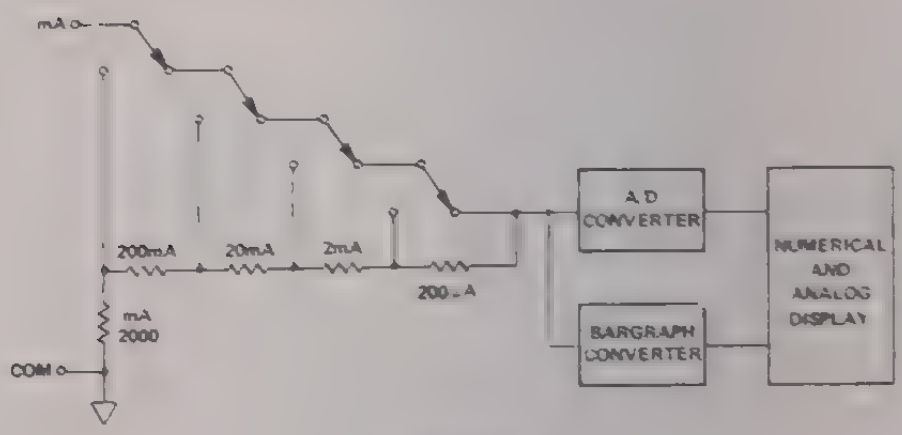
5.2.6 True RMS conversions are limited by their crest factors as to the type of waveform which can be measured. The crest factor is defined as the ratio of the peak value to the RMS value of a periodic waveform.

5.2.7 DC Current Measurements

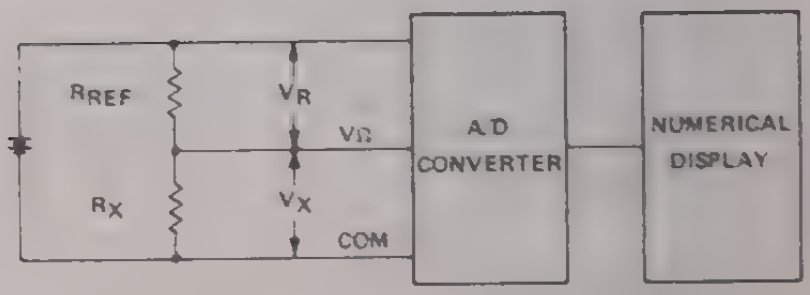
5.2.8 The basic DC current measurement circuit is shown in Figure 5-3(A). The current being measured is connected in series with the "mA" and "COM"

jacks across the internal precision shunt resistance. The value of the shunt resistance depends on the current range selected. The DC voltage developed across the shunt resistor is measured by the A/D Converter.

5.2.9 The full range sensitivity of the A/D Converter is set for 200mV. The internal shunt resistance for each current equals 200mV divided by the full range current. For example, if the full range current is 200μA, the shunt resistance is 1000 ohms.



A. AC CURRENT



B. RESISTANCE

FIGURE 5-3. BASIC DC CURRENT AND RESISTANCE MEASUREMENT CIRCUITS

5.2.10 AC Current Measurements

5.2.11 The basic AC current measurement circuit is essentially the same as the DC current measurements circuit (paragraph 5.2.7), except that the voltage developed across the internal shunt resistance is measured by the AC voltage measurement circuit.

5.2.12 Resistance Measurements

5.2.13 The basic resistance circuit is shown in Figure 5-3(B). The resistance being measured, Rx, is connected to the "V-Ω" and "COM" jacks. A voltage ratio is made by comparing the unknown resistance (Rx) with an internal standard resistance R ref. The voltage ratio is applied to the A/D converter to yield a numerical value which is proportional to the unknown resistance as shown in Figure 5-3(B). The ranges of the resistance measurement circuit are determined by the range switch selected.

5.2.14 Peak Hold

5.2.15 A simplified block diagram of the Differential Peak Hold circuit is shown in Figure 5-4. The "Peak Hold" circuitry consists of a storage capacitor, two diodes, and two isolation amplifiers connected in a unity gain configuration. Initially, the Cs capacitor is discharged. When the "Peak Hold" pushbutton is depressed, the Cs capacitor is charged to either the most positive or negative potential of the input signal via IC 201. The polarity is determined through either diode D300 or D301 by the selection of the "±" switch position. Once the most extreme potential is removed, the diode is reverse biased and the potential is stored in the Cs capacitor. The decay rate of the stored potential is about one count per second.

5.3 SPECIAL CIRCUITS

5.3.1 Bargraph Converter

5.3.2 A simplified block diagram of the Bargraph Converter is shown in Figure 5-5. The bargraph converter is a single-slope, 60 sample per second, absolute value A D circuit that interfaces with a 22-segment liquid crystal display.

5.3.3 The input buffer consists of a gain of five (5) amplifiers and an absolute value converter. The output of the absolute value converter is always negative.

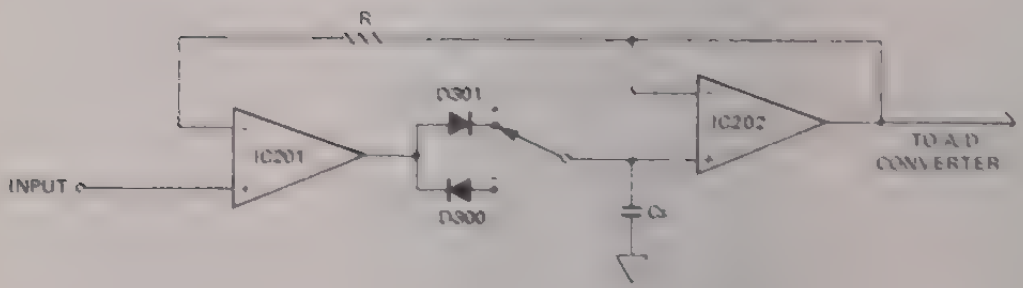


FIGURE 5-4. SIMPLIFIED BLOCK DIAGRAM, PEAK HOLD CIRCUIT

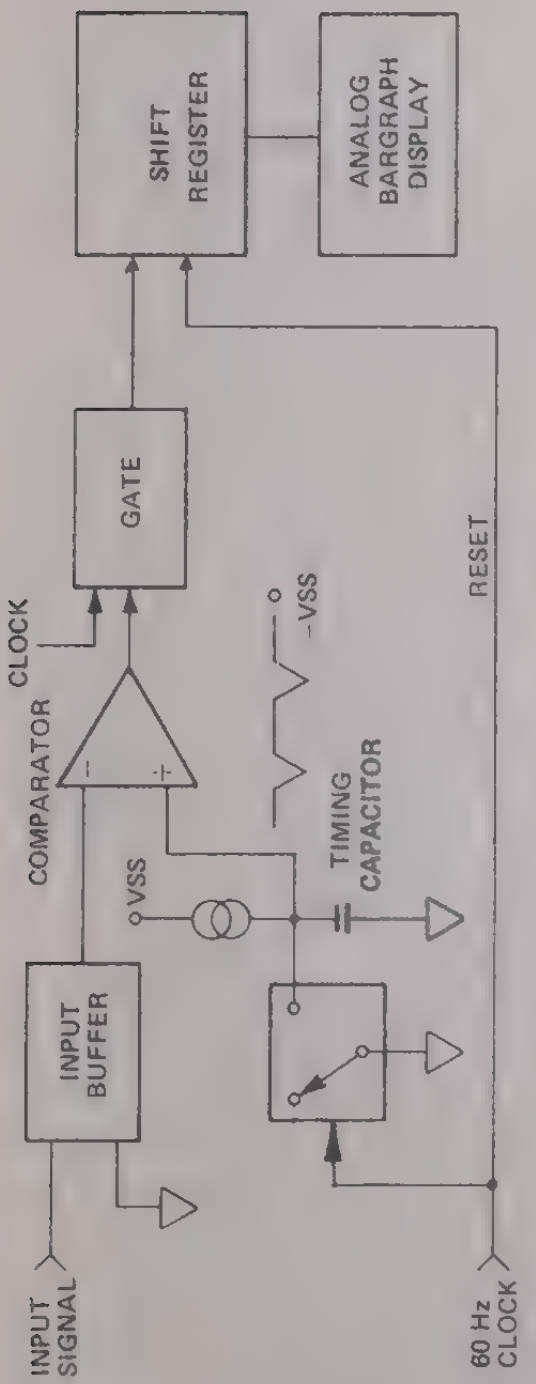


FIGURE 5-5. SIMPLIFIED BLOCK DIAGRAM OF BARGRAPH CONVERTER

5.3.4 A 60 Hz reset pulse, derived from the LCD backplane, is used to synchronize the conversion. The comparator enables the clock from the falling edge of the reset pulse to the point where the timing capacitor voltage exceeds the voltage at the input buffer output. The number of segments displayed equals the number of clock pulses generated. The shift register is reset with every conversion cycle.

5.3.5 Pulse and Continuity Detector

5.3.6 A simplified block diagram of the pulse and continuity detector is shown in Figure 5-6. The absolute-value input signal is compared with a reference voltage at IC101B comparator. Integrated cicruits IC104A and IC104B are edge-triggered monostable multivibrators. IC104A detects a positive - going pulse or "above reference" level and turns on the " ▲ " symbol and holds for 100 milliseconds. Conversely, IC104B detects a negative - going pulse or "below reference" level and turns on the " ▼ " symbol and holds for 100 milliseconds.

5.3.7 If the front panel pushbutton switch "♪ $\widetilde{AC}$" (IN position) is selected in conjunction with the pulse on continuity detection switch, an audio tone coincident with the down arrow " ▼ " symbol will be generated. The tone is generated by a piezioelectric element driven by a push-pull oscillator.

5.3.8 Continuity is a special case of a "below reference" level and, therefore, turns on the " ▼ " symbol when the input test leads are "shorted." Conversely, an open circuit or a "non-shorted" condition represents the "above reference" level and turns on the " ▲ " symbol.

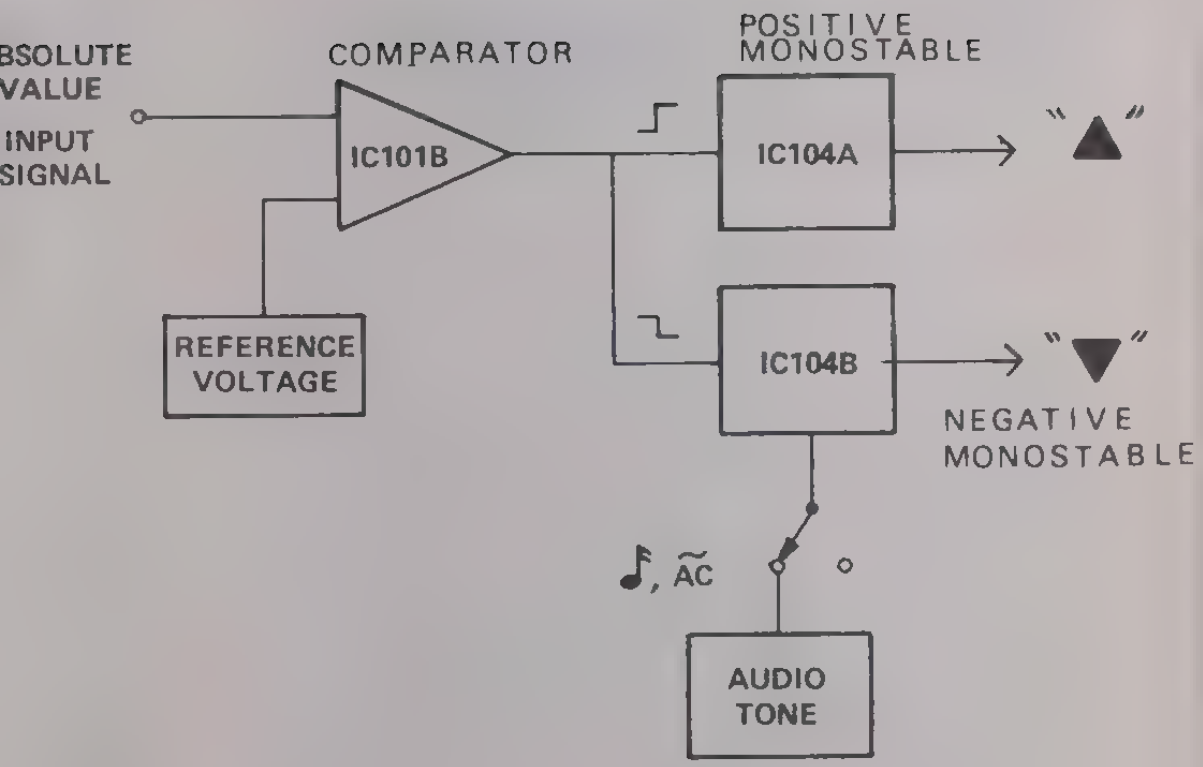


FIGURE 5-6. SIMPLIFIED BLOCK DIAGRAM OF PULSE AND CONTINUITY DETECTOR

SECTION VI
APPLICATIONS

6.1 GENERAL

6.1.1 There are three special functions available with the 467 which expand the test and measurement capabilities of the Instrument. The three functions are:

(a) Peak Hold

(b) Analog Bargraph

(c) Absolute Value Pulse Detector

In this section a few interesting and useful applications of these special functions will be described.

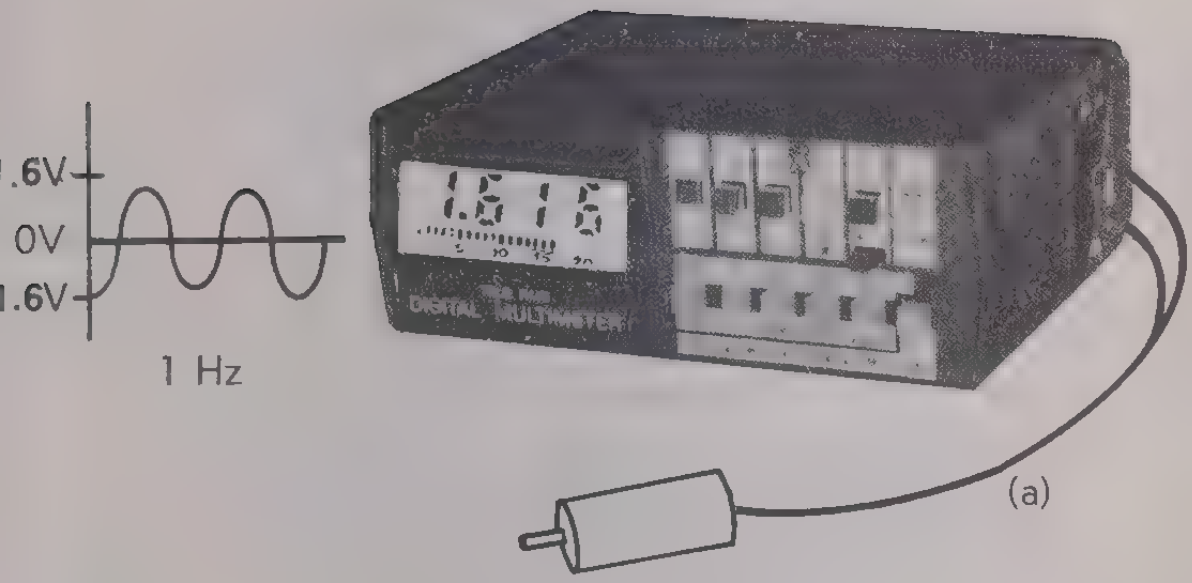
6.2 MEASUREMENT OF LOW FREQUENCY WAVEFORMS

6.2.1 Typical digital multimeters are unable to give accurate or stable readings of AC voltages or currents with frequencies below approximately 10 Hz. This deficiency is due to the signal frequency approaching the DMM sampling rate. However, by using the 467, accurate peak-to-peak measurements can be made, and the waveform can be visually observed if the input frequency is below approximately 5 Hz.

6.2.2 As an example of the low frequency signal measurement application, consider a servo-control system in which the position of a slowly rotating shaft is converted into a voltage proportional to the sine of the shaft's angular position. The test set-up required is shown in Figure 6.1 (a).

6.2.3 To measure the low frequency signal shown in Figure 6.1 (a), use the following procedure:

(a) Connect the test leads from the "V-Ω" and "COM" input jacks across the leads of the shaft position indicator transducer.



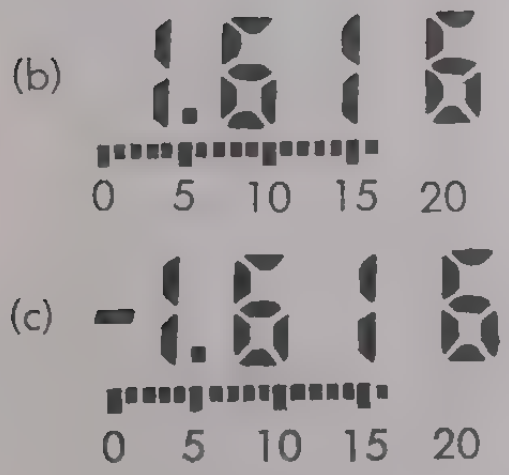


FIGURE 6-1.
LOW FREQUENCY MEASUREMENTS

(b) Set the "V", "DC", and "2V" pushbutton switches of the 467.

(c) Turn on the servo-control system. The analog bargraph will move from 0 to 16 back down to 0, and back up to 16 but with the minus sign displayed in the numerical display. It will then return to 0, and the cycle will repeat. The movement of the bargraph provides a visual indication of the shaft motion.

(d) Depress the PEAK HOLD button with the "±" switch in the "+" position. The positive peak voltage (+1.6V) will be held and displayed as shown in Figure 6.1(b). Note that the bargraph is still following the input signal. The bargraph is not affected by the Peak Hold function.

(e) With the PEAK HOLD switch depressed, slide the "±" switch to the "−" position. The negative peak voltage (−1.6V) will be held and displayed as shown in Figure 6.1(c). Note that the bargraph is still following the input signal.

6.3 PEAKING AND NULLING

6.3.1 Analog (moving pointer) meters have traditionally been preferred over digital instruments for applications requiring trend analysis. These include peaking and nulling, in which the absolute reading is less important than the variation in the reading. For these applications, ignore the numerical display, and observe the movement of the analog bargraph display, which is analogous to the moving pointer. Once a peak or null has been reached, the reading of the signal can be taken from the numerical display.

6.4 USE OF THE 467 AS A LOGIC PROBE

6.4.1 The use of digital electronics has spread into the consumer field, with applications in even low-priced appliances and entertainment products, as well as through the industrial market. For this reason a logic probe to analyze these digital circuits is becoming increasingly useful.

6.4.2 In essence, a logic probe indicates the logic state at a point in a digital circuit. This state will be a "1" or a "0". A "1" state most often indicates a positive voltage, and a "0" state is near circuit ground (there are circuits which use negative logic, but this is compensated for by the 467, which operates as an absolute value logic probe). The level of a "1" state is usually between +2.5 and +5 VDC for TTL, and between +5 and +15 VDC for CMOS logic circuitry.

6.4.3 As an example of the logic probe function of the 467, consider a digital circuit putting out a string of pulses with various repetition rates. The circuit uses CMOS, with a "1" being +15 VDC and a "0" being circuit ground. The test set-up and pulse train are shown in Figures 6.2 (a) and (b).

6.4.4 To analyze the logic waveform shown in Figure 6.2 (b):

(a) Connect the test lead from the "COM" input jack to the circuit ground. Connect the test lead from the "V-Ω" input jack to the point in the circuit to be analyzed.

(b) Depress the "Ω▲▼" and "200k▲▼" buttons. If desired, the continuity buzzer can be turned on by depressing the "♪ ÂC" button. The buzzer will coincide with the "▮" display.

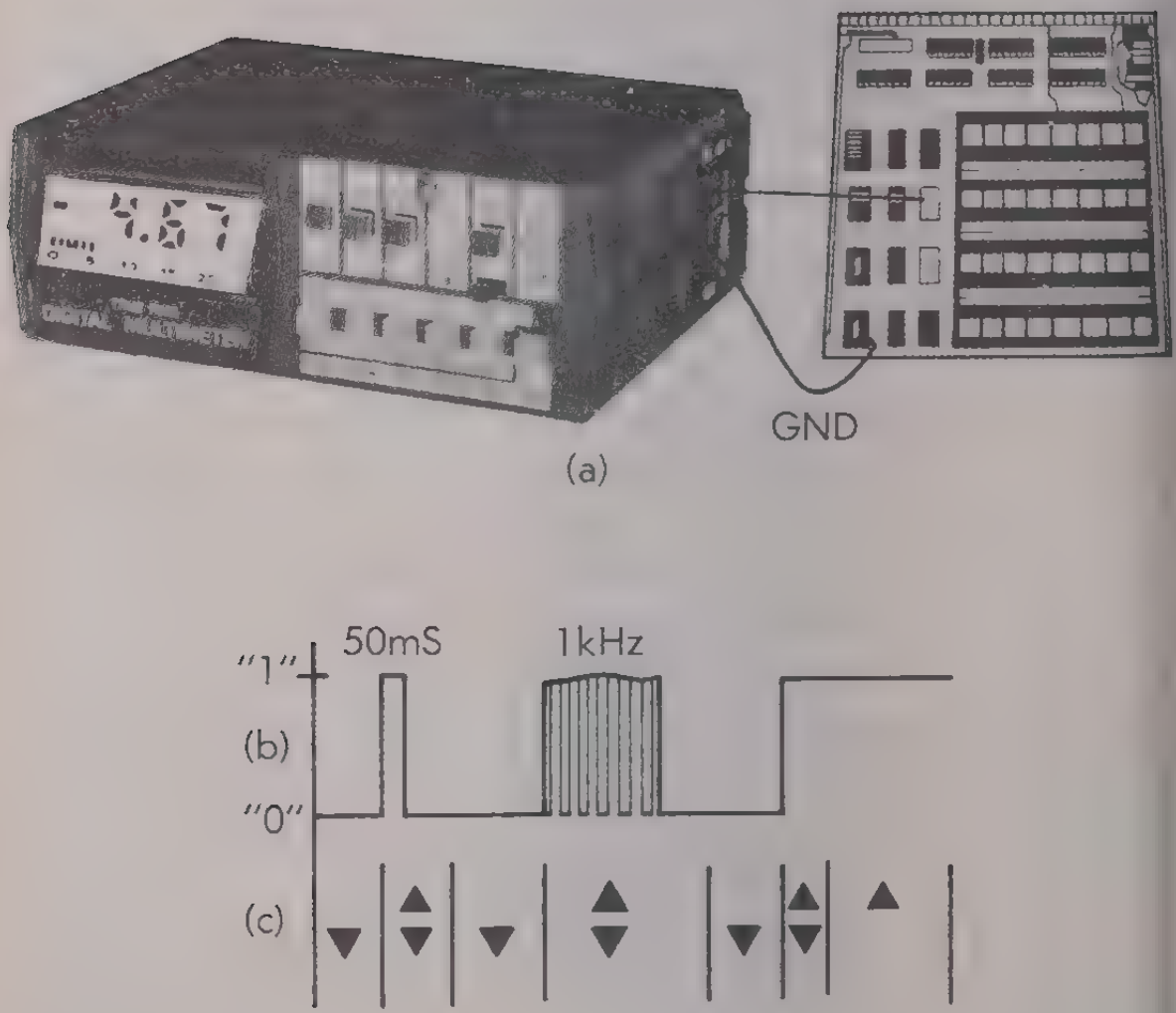


FIGURE 6-2.
USE OF 467 AS A LOGIC PROBE

(c) The logic waveform in Figure 6.2 (b) will produce the display shown in Figure 6.2 (c). Note that the reading in the numerical display is meaningless. Also note that the pulse stretcher circuit in the 467 will keep either the "▲" or the "▼" display element on for approximately 100 mS after the logic state changes. This enables the operator to detect pulses as short as 50μs in duration. This also means, however, that detected changes in state slightly lag the actual changes, as shown in Figure 6.2 (c).

6.5 LOCATION OF WIRING INTERMITTENTS

6.5.1 It is sometimes necessary to locate an intermittent wire or connection in a piece of equipment. This can be very time consuming if the intermittent is infrequent or of very short duration.

6.5.2 To use the 467 to locate an intermittent:

(a) Connect the test leads from the "V-Ω" and "COM" input jacks across the wire or connection which is suspected of being intermittent. Depress the "$\frac{\blacktriangle}{\Omega}$" and "200Ω" buttons. Put the "±" switch in the "+" position.

(b) With continuity indicated, depress the PEAK HOLD button.

(c) If the reading on the Instrument is later seen to be higher than when the PEAK HOLD button was depressed, an intermittent has occurred.

(d) The continuity indicator is unaffected by the Peak Hold function, and can be used to indicate continuity at the present moment.

6.6 PEAK IN-RUSH CURRENT MEASUREMENTS

6.6.1 Most types of line-operated equipment, from motor driven appliances to consumer electronic products, draw a heavy surge of line current when they are turned on. This current may be many times the rated operating current of the product. It is occasionally desirable to measure this surge current.

6.6.2 As an example of the in-rush current measurement application: Suppose that a television set, which draws 1 ampere when operating, is to be checked for peak in-rush current to make certain that a replacement power switch is capable of handling the surge. Since the in-rush current is likely to be over two amperes, the limit of the 467 current measurement capability, a Simpson 153-2 AMP-CLAMP will be used. (Current range from 2 Amps to 200 Amps.) The set up required is shown in Figure 6.3 (a).

6.6.3 To measure the input surge current:

(a) Close the AMP-CLAMP jaws around one side of the AC supply cord. This can be done conveniently by using a Simpson 151-2 line splitter.

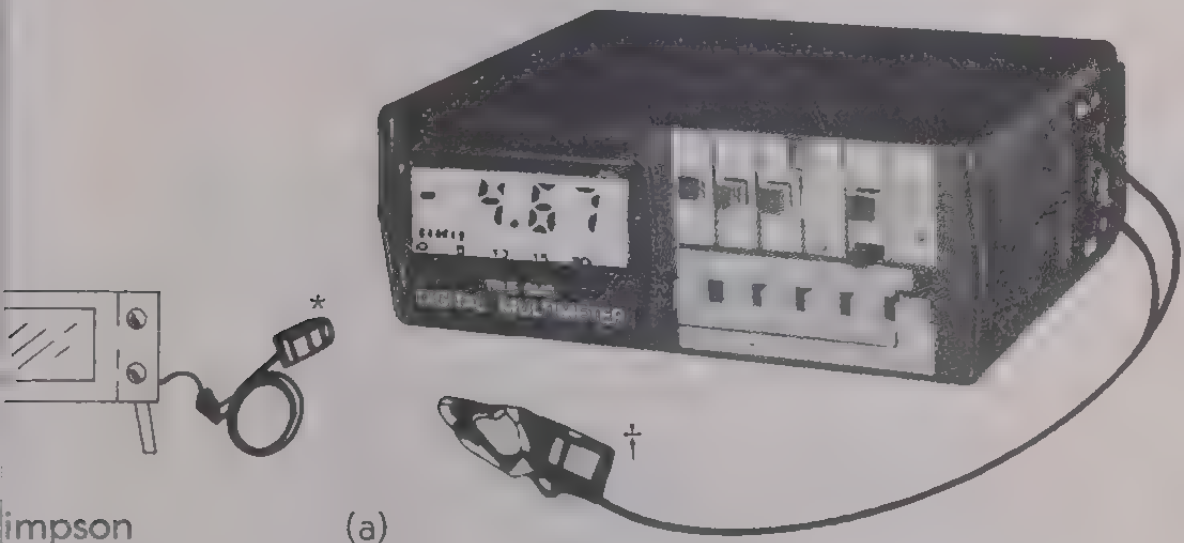
(b) Connect the AMP-CLAMP to the "V-Ω" and "COM" input jacks.

(c) In this case, a surge current between 2 and 20 amps is expected, so the AMP-CLAMP is set to the "20A" position. Referring to the chart on the AMP-CLAMP body, the "2V" button on the 467 is depressed. Depress the "V" button. Set for "$\bar{D}\bar{C}$".

(d) With the 467 reading 0, depress the PEAK HOLD button, with the "±" switch in the "+" position.

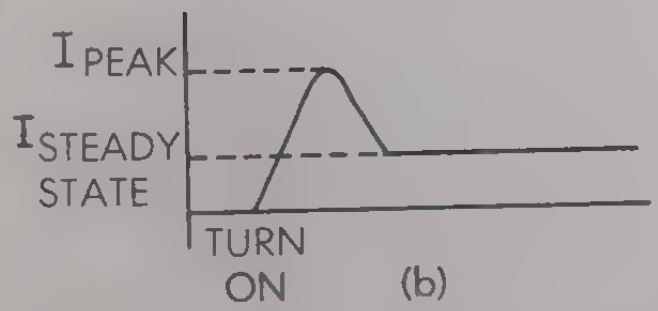
(e) Turn on the television set. The peak in-rush current will be captured in the numerical display.

(f) Set for "AC", "V" and release the PEAK HOLD switch to measure the steady-state current.



impson
* 151-2
† 153-2

(a)



(b)

FIGURE 6-3.
IN-RUSH CURRENT MEASUREMENT

SECTION VII
OPERATOR MAINTENANCE

7.1 GENERAL

7.1.1 This section will describe the necessary procedures needed to effectively service the 467.

7.2 COVER REMOVAL

7.2.1 The rear cover can be removed for servicing by using the following procedures:

WARNING

Remove all power and connections to the Instrument before removing the case cover. Do not operate the Instrument with the rear cover removed.

a. Set the POWER switch to the OFF position.
b. Disconnect the test leads from the Instrument.
c. Turn the two screws on the back cover counterclockwise until the rear cover is removed. (The two screws will remain in the cover.)
d. Reverse this procedure when replacing the cover.

7.3 BATTERY INSTALLATION/REPLACEMENT PROCEDURES

7.3.1 Use the following procedure to install or replace the battery:

a. Set the POWER switch to the OFF position.
b. Remove both test leads from external circuit connections and from the 467 input terminals.
c. Remove the rear cover by turning the two screws counterclockwise.

WARNING

Remove both test leads from input terminals before removing the cover. Do not operate the instrument with the rear cover removed.

d. Lift the battery from the compartment and remove the battery connector.

e. Press the battery connector on the new battery and return the battery to the compartment.

f. Replace the rear cover.

NOTE: When a battery reaches the end of its useful life, replace it promptly. Failure to do so may result in corrosion at the battery contacts.

7.4 FUSE REPLACEMENT

7.4.1 Both AC and DC current functions are protected up to 2 amps with two fuses, F1 and F2. The fuses are connected in series and are accessible with the removal of the rear cover (Figure 8-1).

7.4.2 Fuse types:

F1: 3AG, 2A, 250V, Normal blow.

F2: BBS, 3A, 600V

7.4.3 Fuse Replacement Procedures:

a. Set the POWER switch to the OFF position.

b. Remove both test leads from external circuit connections and from the 467 input terminals.

c. Remove the rear cover by turning the two screws counterclockwise.

d. Carefully remove and replace the defective fuses(s).

WARNING

The combination of fuses provided in this Instrument will perform properly only when the specified types and values of fuses are used. Using incorrect fuses will reduce the protection afforded to the Instrument and can endanger the operator if he's working in high voltage, high power circuits.

e. Replace the rear cover.

7.5 CARE:

WARNING

Do not attempt to clean this Instrument with the test leads connected to a power source.

a. Immediately clean all spilled materials from the Instrument and wipe dry. If necessary, moisten a cloth with soap and water to clean plastic surfaces.

b. Do not allow the battery to fully discharge. (A completely discharged battery may be forced into reverse polarity which will shorten battery life.)

c. Whenever possible, avoid exposure to or usage in areas which are subject to temperature and humidity extremes, vibration or mechanical shock, dust or corrosive fumes, or strong electrical or electromagnetic interferences.

7.5.1 Monthly Care: Verify Instrument calibration by performing operational checks using known value sources. If a need for calibration is indicated, contact the nearest Authorized Service Center.

7.5.2 Annual Care: It is recommended that the Instrument be returned annually to an Authorized Service Center or to the factory for a complete overall check and calibration.

7.5.3 Storage: When the Instrument is not in use, store it in a location free from temperature extremes, dust, corrosive fumes, and mechanical vibration or shock.

WARNING

The following servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION VIII
SERVICING INSTRUCTIONS

8.1 GENERAL

8.1.1 The following paragraphs discuss troubleshooting procedures and replacement parts for the 467. Read and heed these instructions carefully.

8.2 TROUBLESHOOTING

8.2.1 If the Instrument does not yield satisfactory results, follow these procedures before attempting maintenance on the Instrument.

a. Check that the PEAK HOLD pushbutton switch is set to the OUT position for normal operations.

b. Check that all switches are positioned correctly for parameter and range of the input being measured and that the measurement situation is within the rating of the Instrument.

c. Be sure that the battery is properly installed (paragraph 7.3).

d. Ensure that the environment in which the Instrument is being used is within the Instrument specifications.

e. Inspect the device being measured and the measurement test set-up to ensure that proper shielding and grounding techniques have been used. Also, consider whether the Instrument is significantly affecting the circuit being measured.

8.2.2 If the steps taken in paragraphs 8.1.1 do not yield satisfactory results, refer to the troubleshooting chart (Table 8-1). If further assistance is needed, contact an Authorized Service Center.

TABLE 8-1. TROUBLESHOOTING CHART

- **Symptom:** Symbol "B" appears on display.

  Probable Causes: Battery reached the end of its useful life.

  Cure: Replace the battery as noted in paragraph 7.3.

- **Symptom:** No display or faded display when the Instrument is turned "ON."

  Probable Causes: Battery defective, not installed properly, making poor contact or missing.

  Cure: Remove cover and check that the battery is installed correctly and making good contact. (Refer to paragraph 7.3 for replacement.)

- **Symptom:** Indications fluctuate and/or drift, even though indication is satisfactory at 000 with the input terminals shorted, and at 1000 counts when using a stable and low impedance source.

  Probable Causes: Fluctuations, and/or drift are being generated by the circuit being measured or the measurement test set up.

  Cure: Use proper shielding grounding techniques and connections to minimize "pick-up" of unwanted signals due to ground loops, poor connections, and capacitive and/or inductive coupling.

- **Symptom:** Slow response. Operation OK when using a low impedance input.

  Probable Causes: Parameter being measured has a high source impedance.

  Cure: None required.

- **Symptom:** Accuracy not within specifications when checked with a stable higher accuracy (at least 5 times better) low impedance (voltage measurements) source.

  Probable Causes: Instrument is out of calibration.

  Cure: Contact the nearest Authorized Service Center.

- **Symptom:** Operation normal on all functions and ranges except AC and DC Current.

  Probable Causes: Current fuse F1 open.

  Cure: Replace fuse F1 (paragraph 7.4).

- **Symptom:** Operation normal on all functions and ranges except AC and DC Current (F1 checks OK).

  Probable Causes: Current fuse F2 open.

  Cure: If F2 has been blown, a large amount of energy has been applied to the current ranges. Circuit conditions must be corrected before replacing F2.

8.3 REPLACEMENT PARTS AND SCHEMATIC DIAGRAM

8.3.1 This section contains information for ordering replacement parts and shows the Schematic Diagram (Figure 8-1). Table 8-2 lists parts in alphanumeric order of their reference designators and indicates their description (Refer to Table 1-2 for Items and Accessories Furnished With This Instrument.)

8.3.2 To obtain replacement parts, address order to the nearest Authorized Service Center (listed on the last pages of this manual). Refer to paragraph 2.3.1 for ordering instructions.

TABLE 8-2. REPLACEMENT PARTS

Symbol	Description	Part No.
	Battery, 9V Alkaline (NEDA 1604A)	5-114907
	Test Lead Set, Catalog #00043	10-864590
F1	Fuse, 2A, 250V, 3AG	1-112911
F2	Fuse, 3A, 600V, BBS	6-110906
C100	Capacitor, 56PF, 1kV, Ceramic	5-119655
C101	Capacitor, variable 1-5PF	5-119544
C102	Capacitor, 0.068UF, 10%, 100V, Mylar	5-119604
C103, 111, C112	Capacitor, 0.01UF, 50V, Ceramic	5-113184
C104, 106	Capacitor, 100PF, 1000V, Ceramic	5-113217
C105, 107	Capacitor, 0.01UF, 100V, Mylar	5-117278
C108, 113	Capacitor, 15μF, 16V, Tantalum	5-115534
C109	Capacitor, 1000PF, $\pm$5%, 25V, Polystyrene	5-117577
C110	Capacitor, 470PF, 5%, 100V, Polystyrene	5-118406

Symbol	Description	Part No.
C114	Capacitor, 0.1 μF, 50 VDC, Ceramic	5-119660
C115	Capacitor, .002μF, 1kV Ceramic	1-113855
C200		
C214, 211	Capacitor, 0.047μF, 100V, Mylar	5-117202
C201, 203, C204	Capacitor, 15UF, 16V, Tantalum	5-115534
C212	Capacitor, 0.1μF, ±5%, 100V, M.P.	6-112365
C202	Capacitor, 3.3UF, 10V, Tantalum	5-117605
C205	Capacitor, 1μF, 16V, Tantalum	5-115531
C206	Capacitor, 0.47μF, 100V, Mylar	6-111168
C208	Capacitor, 100μF, 10V, Electrolytic	5-117206
C209	Capacitor, 470PF, 500V, Ceramic	1-115832
C210	Capacitor, 220pF, ±5%, Polystyrene	5-117571
C213	Capacitor, .22μF, ±10%, 250V, Met. Mylar	6-110364
C215	Capacitor, 100PF, 1kV, Ceramic	5-113217
C216	Capacitor, 0.1μF, 50V, Ceramic	5-119660
C217	Capacitor, 39pF, 1kV, Ceramic	5-118561
D100	Diode, 1N5059	5-113826
D101, 102, D103	Diode, 1N914	5-112004
D104	Rectifier, Bridge, MDA200	6-111240
D200	Diode, Zener, 1N4742A, 12V, 1W	5-113866

Replacement Parts

Symbol	Description	Part No.
D201, 202, D203, 204 207 208	Diode, 1N914	5-112004
D205, 206 D300, 301	Diode, DE-112	6-112270
IC100	IC Dual, OP Amp	6-112219
IC101	IC Dual, OP Amp	6-110905
IC102	IC CMOS Triple, 2 channel analog, mux/demux	6-112215
IC103	IC Adjustable Current Source	6-112220
IC104	IC CMOS Dual, Monostable Multivibrator	6-112217
IC105	IC CMOS Quad Gate, 2 Input NAND	6-112216
IC106	IC CMOS 32 Bit Shift Register	6-112213
IC107	IC CMOS Quad, 2 Input, EXOR Gate	6-111150
IC200	IC TRMS Converter	6-112214
IC201, 202	IC OP Amp	6-112218
IC203	IC CMOS Quad, 2 Input, EXOR Gate	6-111150
IC204	Diode, Reference, 1.2V, LM385Z	6-112221
IC205	IC A/D Converter	6-110920
MOV100, 101, MOV102, 103, MOV104	Resistor, Special M.O.V.	6-110694
Q100	Transistor 2N4123	5-115931
Q200, 201, Q206, 210, Q211, 212	Transistor 2N4123	5-115931
Q202, 207	Transistor MPS3702	5-113864
Q203, 204, Q209	Transistor 2N4302	6-110059

Replacement Parts

Symbol	Description	Part No.
Q208	Transistor D40DIN	5-115479
R100	Resistor Leads Formed	3-812808
R101	Resistor Assy, Current Limiter	10-675563
R102	Resistor, 99.8Ω, 0.1%, ¼W	6-112239
R103	Resistor, 900Ω, 0.25%, ¼W	5-116273
R104	Resistor, 90Ω, 0.25%, ¼W	5-116272
R105	Resistor, 9.0Ω, 0.25%, ¾W	5-118410
R106	Resistor, 3.9kΩ, 5%, ¼W	5-118369
R107	Resistor, 1 MEGΩ, 1%, ¼W	5-117693
R108	Resistor, 249kΩ, 1%, ¼W	6-112242
R109	Resistor, 1.0kΩ, 1%, ¼W	5-115490
R110, 112, R116, 117, R128, 135, R142	Resistor, 100kΩ, 5%, ¼W	5-118168
R111	Potentiometer, 500kΩ	6-112245
R113, 114	Resistor, 100kΩ, 1%, ¼W	5-116142
R115	Resistor, 4.32kΩ, ±1%, ¼W	6-112241
R118	Resistor, 22kΩ, 5%, ¼W	5-118163
R119	Resistor, 1.6 MEGΩ, 5%, ¼W	6-110156
R120	Resistor, 3.3 MEGΩ, 5%, ¼W	6-112250
R121, 122, R123, 124, R125, 130, R131, 133, R136, 137, R138, 139, R143	Resistor, 1 MEGΩ, 5%, ¼W	5-118305
R126	Potentiometer, 100kΩ	6-111613
R127	Resistor, 47kΩ, 5%, ¼W	5-119647
R129, 132	Resistor, 10 MEGΩ, 5%, ¼W	5-116632
R134	Resistor, 240kΩ, ±5%, ¼W	6-111124
R140	Resistor, Special, Attenuator Network	6-112222

Replacement Parts

Symbol	Description	Part No.
R141	Resistor, Special, .1 & .9Ω	6-111235
R200	Resistor, Special, HVCL, 500Ω, 750V	3-812804
R201	Resistor, 10kΩ, 5%, ¼W	5-118161
R202, 205, R213, 214, 235, R219, 236, R238	Resistor, 1 MEGΩ, 5%, ¼W	5-118305
R221	Resistor, 470kΩ, 5%, ¼W	5-118169
R203	Potentiometer, 200Ω	6-112023
R204, 215	Resistor, 22kΩ, 5%, ¼W	5-118163
R206	Potentiometer, 500kΩ	6-112245
R207	Resistor, 10MΩ, 5%, ¼W	5-116632
R208	Resistor, 200Ω, 1%, ¼W	5-119741
R209, 210, R218, 223, R225, 232, R233, 234	Resistor, 100kΩ, 5%, ¼W	5-118168
R211	Resistor, 3.9kΩ, 5%, ¼W	5-118369
R212, 216	Potentiometer, 20kΩ	6-112244
R217	Resistor, 300Ω, 5%, ¼W	5-119630
R222	Resistor, 130kΩ, 5%, ¼W	5-117709
R224	Resistor, 43.2kΩ, 1%, ¼W	6-111254
R226	Resistor, 16.9kΩ, 1%, ¼W	6-112240
R227	Potentiometer, 5kΩ	6-112275
R228	Resistor, 221kΩ, 1%, ¼W	5-117526
R229	Resistor, 100kΩ, 1%, ¼W	5-116142
R230	Resistor, 130kΩ, 5%, ¼W	5-117709
R231	Resistor, 91kΩ, 5%, ¼W	6-112278
R237	Resistor, 160kΩ, 5%, ¼W	6-112360
	Board Assy, Peak-Hold	10-864628
	Board Assy, Peak-Hold & Switch	10-864627
	Board, PC Assy Display	10-864630

Replacement Parts

Symbol	Description	Part No.
	Board, PC Assy Rear	10-864632
	Button, Black	6-110114
	Button, Grey	6-110115
	Button, Red	6-110113
	Button, White	6-110705
	Case Assy, Black	10-864655
	Case Assy, Blue	10-864642
	Connector Assy, Input	10-864651
	Connector, Female, 34PIN	6-111159
	Connector, Receptacle, 12PIN	6-112209
	Connector, Receptacle, 34PIN	6-111159
	Cover Assy, Black	10-560302
	Cover Assy, Blue	10-560301
	Shield Assy, Function PCB	10-864635
	Shield Assy, Range PCB	10-864639
	Socket, IC, 8 PIN DIP	6-112225
	Socket, IC, 14 PIN DIP	6-112226
	Socket, IC, 16 PIN DIP	6-112227
	Socket, IC, 40 PIN DIP	6-112228
	Switch, Function, 6 Position, Pushbutton	6-112231
	Switch Range, 6 Position, Pushbutton	6-112230
	Transducer Assy, Welded	10-864659

XEROX PART NUMBERS FOR DIGITAL MULTIMETER TEST LEADS

The basic DMM Test Lead Kit which is to be ordered with each DMM is **600T1617** and contains:

PART NUMBER	DESCRIPTION
600T1661	1 - Pair Red & Black Meter Test Leads
600T1618	1 - Pair Red & Black Spring Hooks
600T1650	1 - Pair Red & Black Shrouded Croc Clips
600T1651	1 - Pair Red & Black Test Prods

Any of these pieces may be ordered separately by part number.

	Fuses for 600T1515/600T1616
708WO1601	3 AG, 2 Amp, 250V Normal Blow Fuse
108P171	BBS-3, 3 Amp, 600V High Energy Fuse
	Battery Replacement
99P3027	1 - 9V Battery, Alkaline NEDA 1604 A
	High Voltage Probe for 600T1515/600T1616
600T1613	1 - 40K.V. HV Probe
	MOD III Electrometer Interface
600T1653	1 - 6K.V. HV Probe
600T1652	1 - Black Stackable Jumper Lead
	Replacement Meter Leads for Analog Meter 600T860
600T1660	1 - Pair Red & Black Non-Stackable Banana to Banana

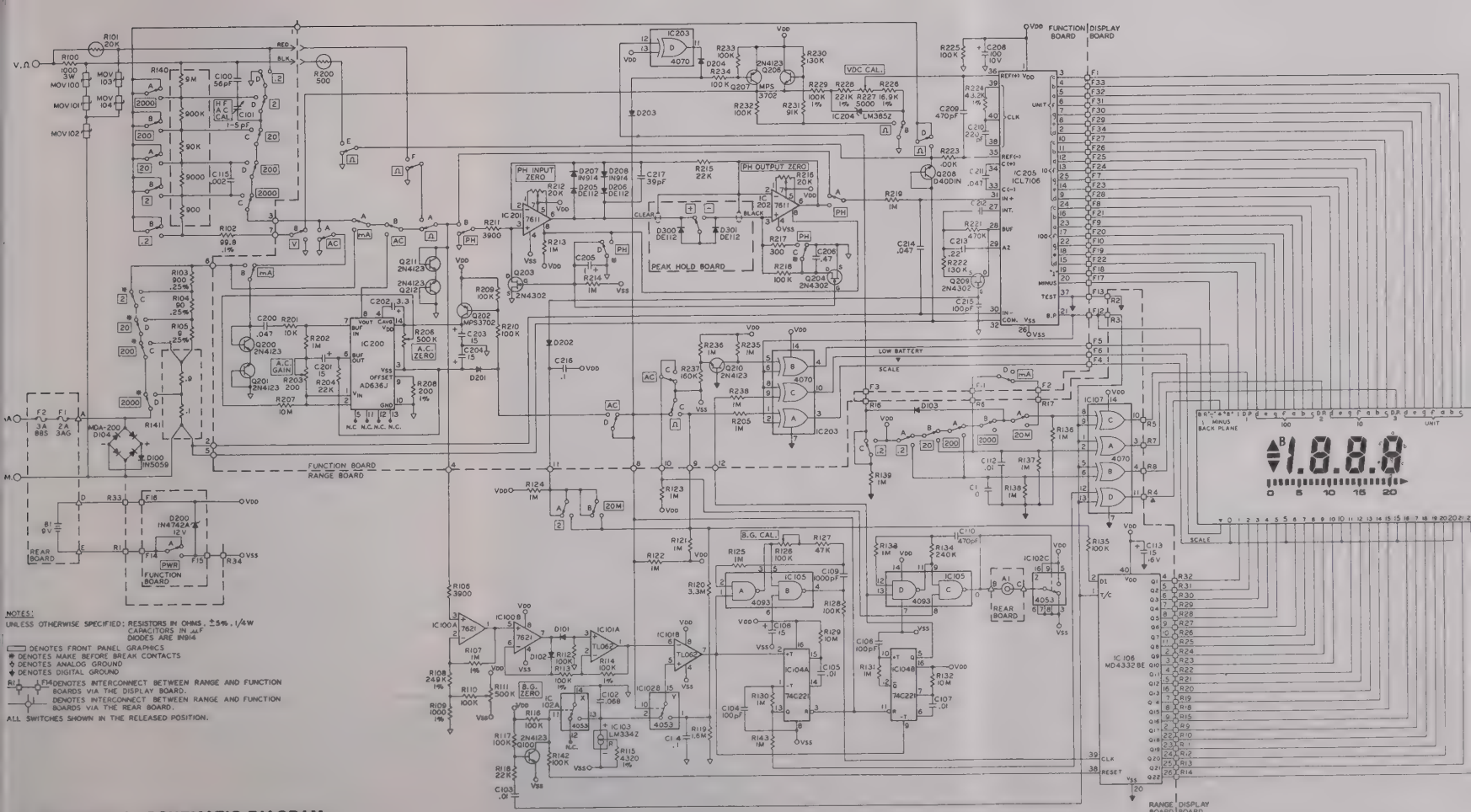


FIGURE 8-1. SCHEMATIC DIAGRAM

Quality is the indispensable component of every Instrument manufactured by Simpson . . .